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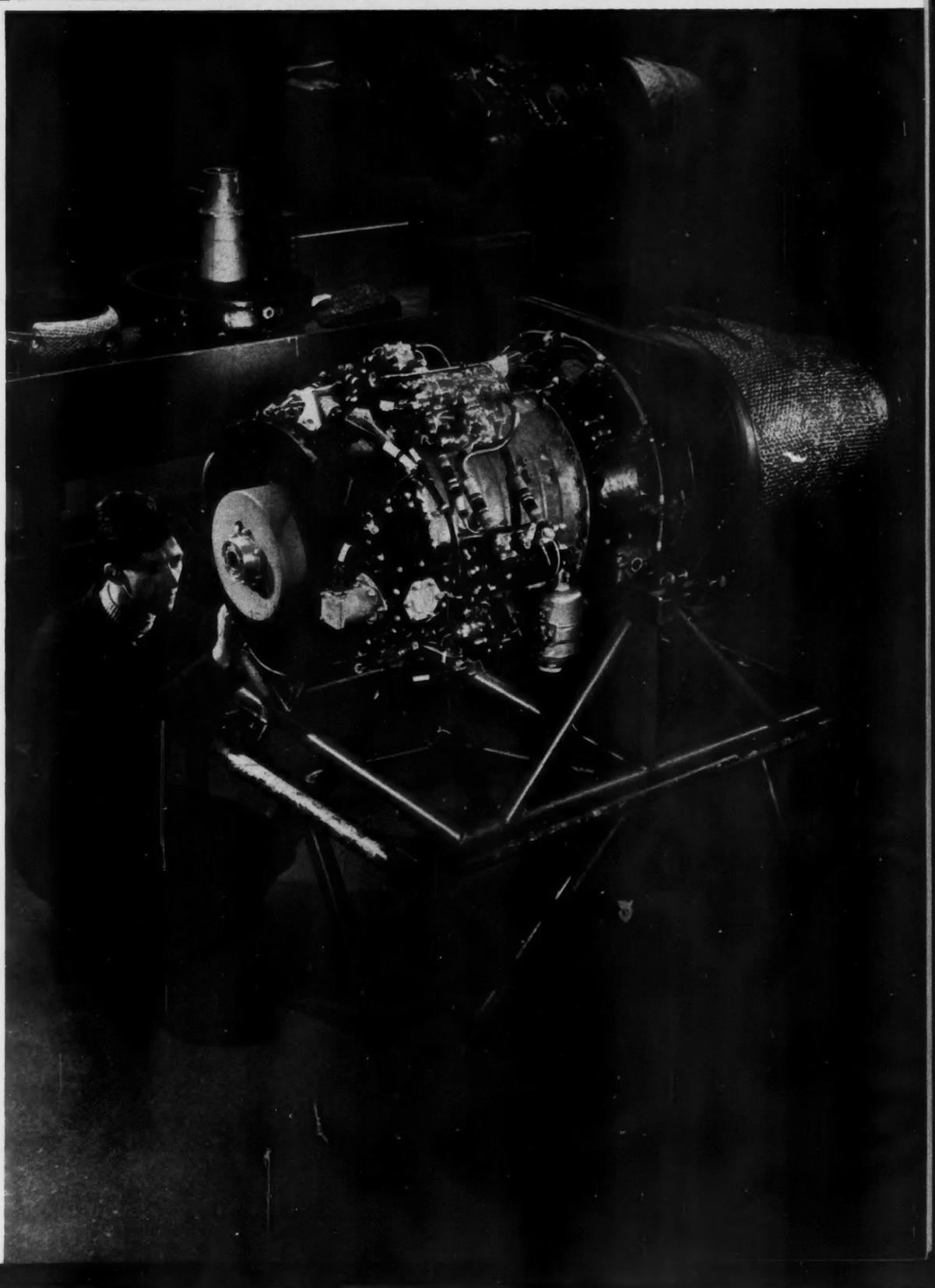

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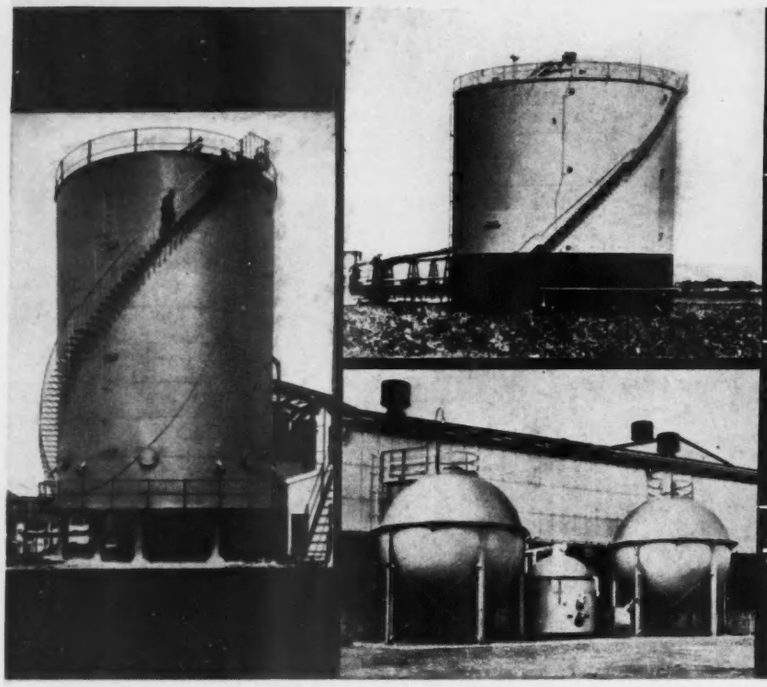

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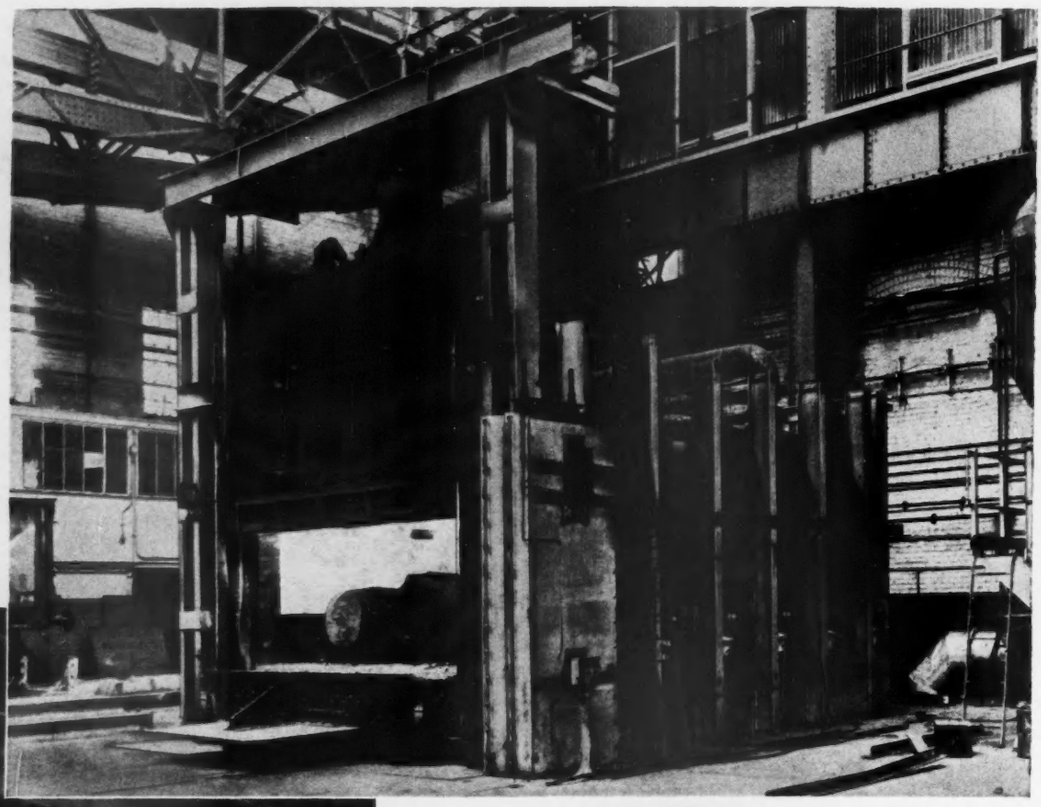

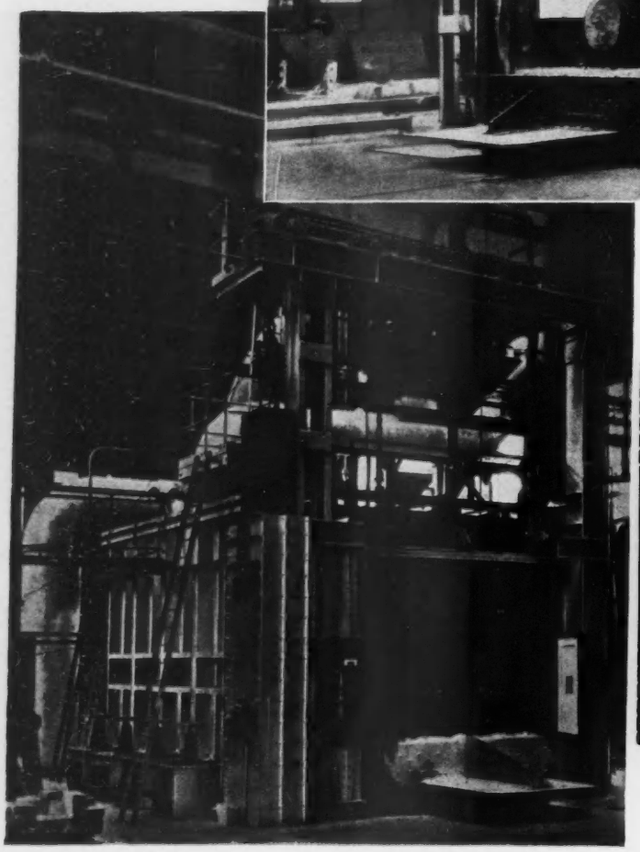

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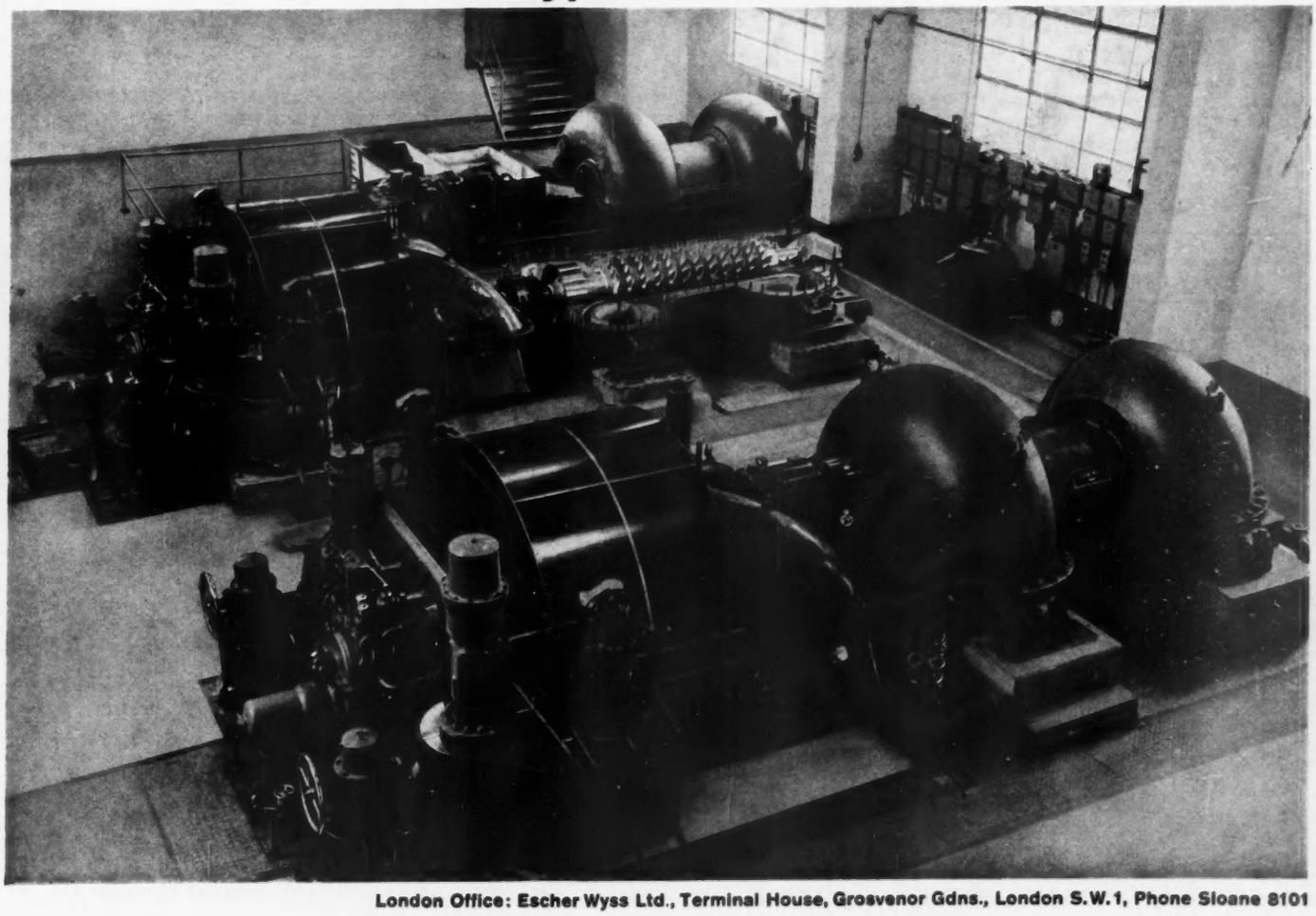

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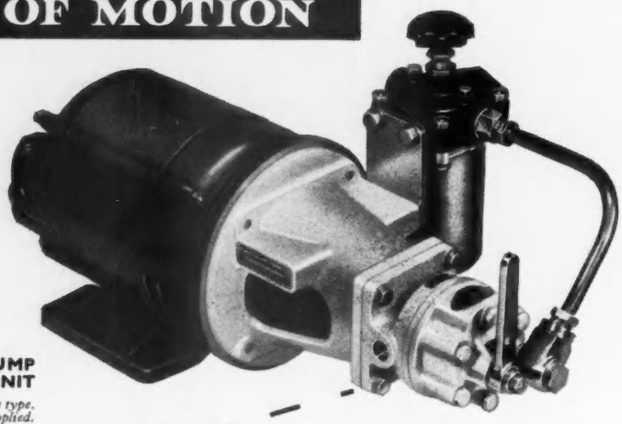

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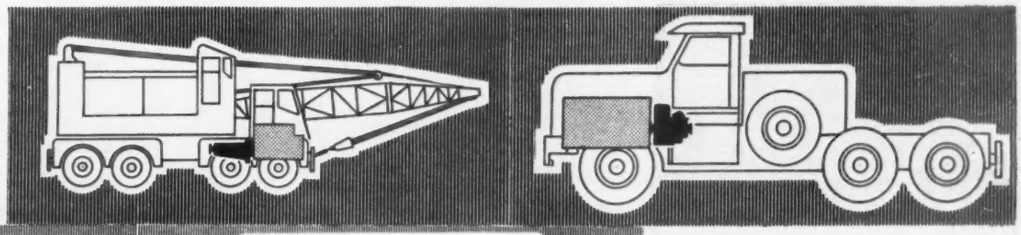

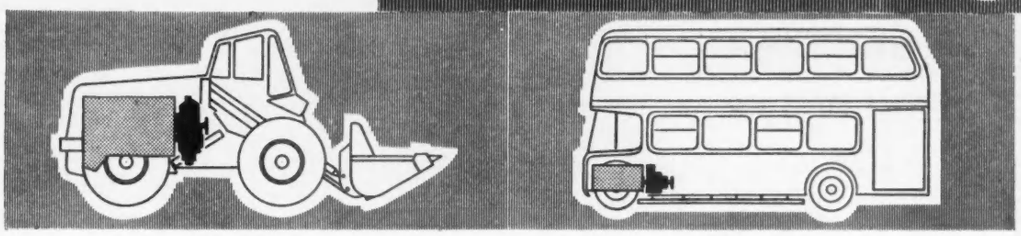

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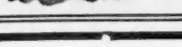

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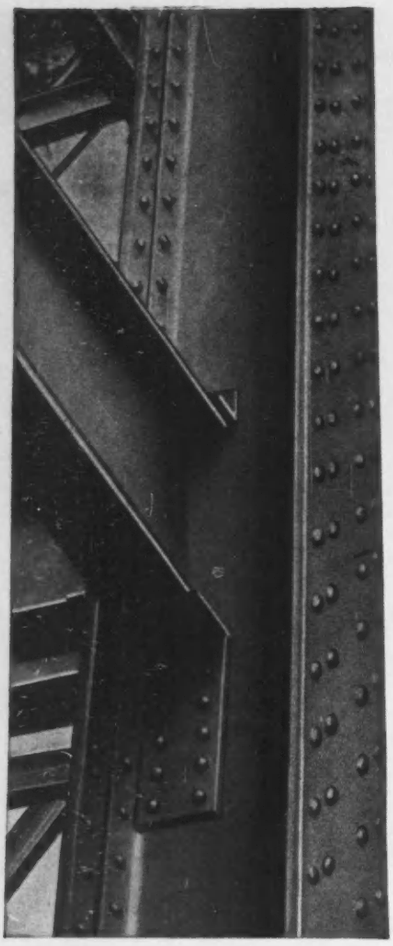

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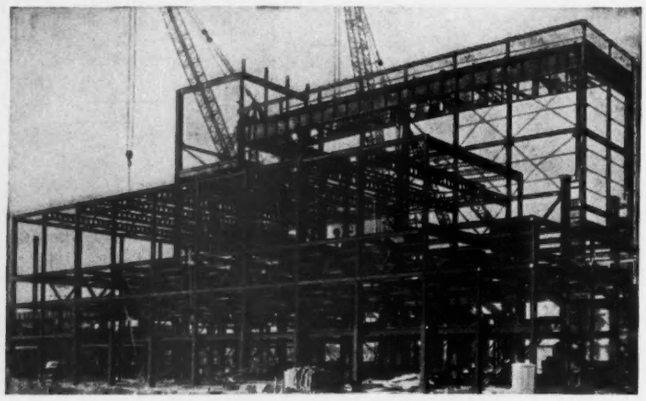

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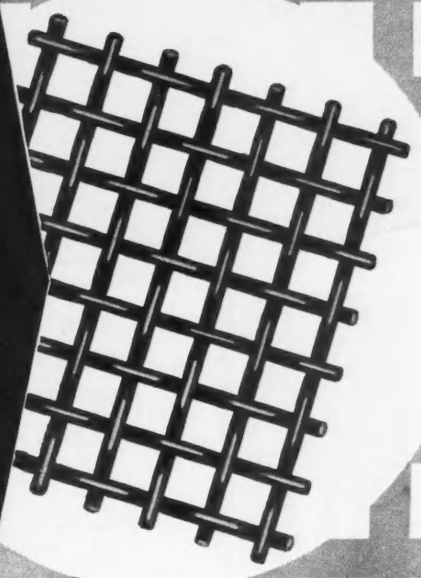

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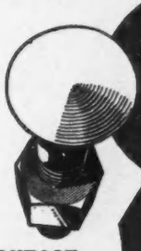

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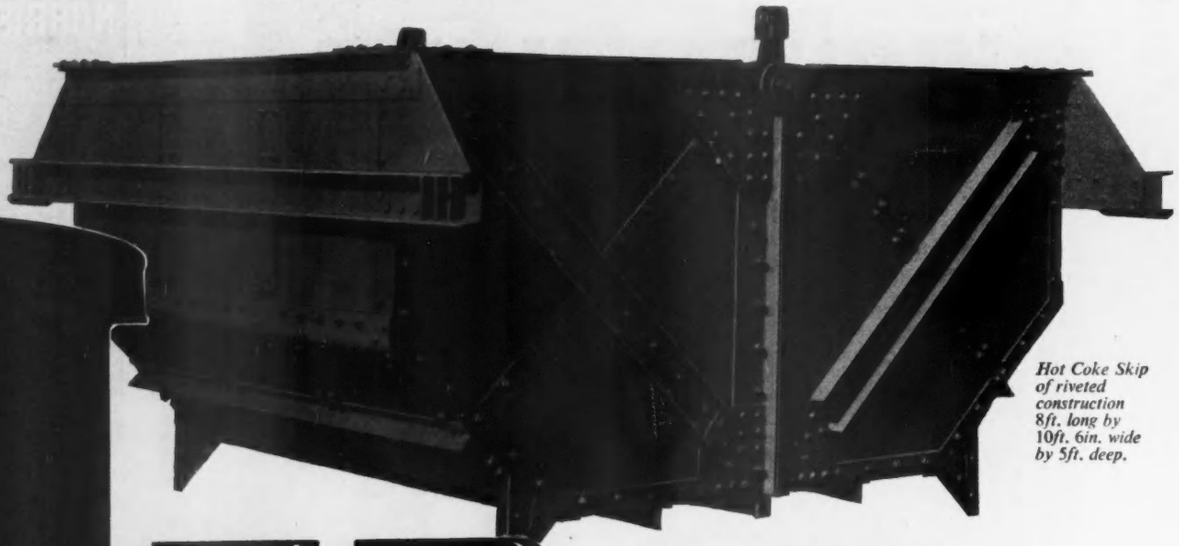

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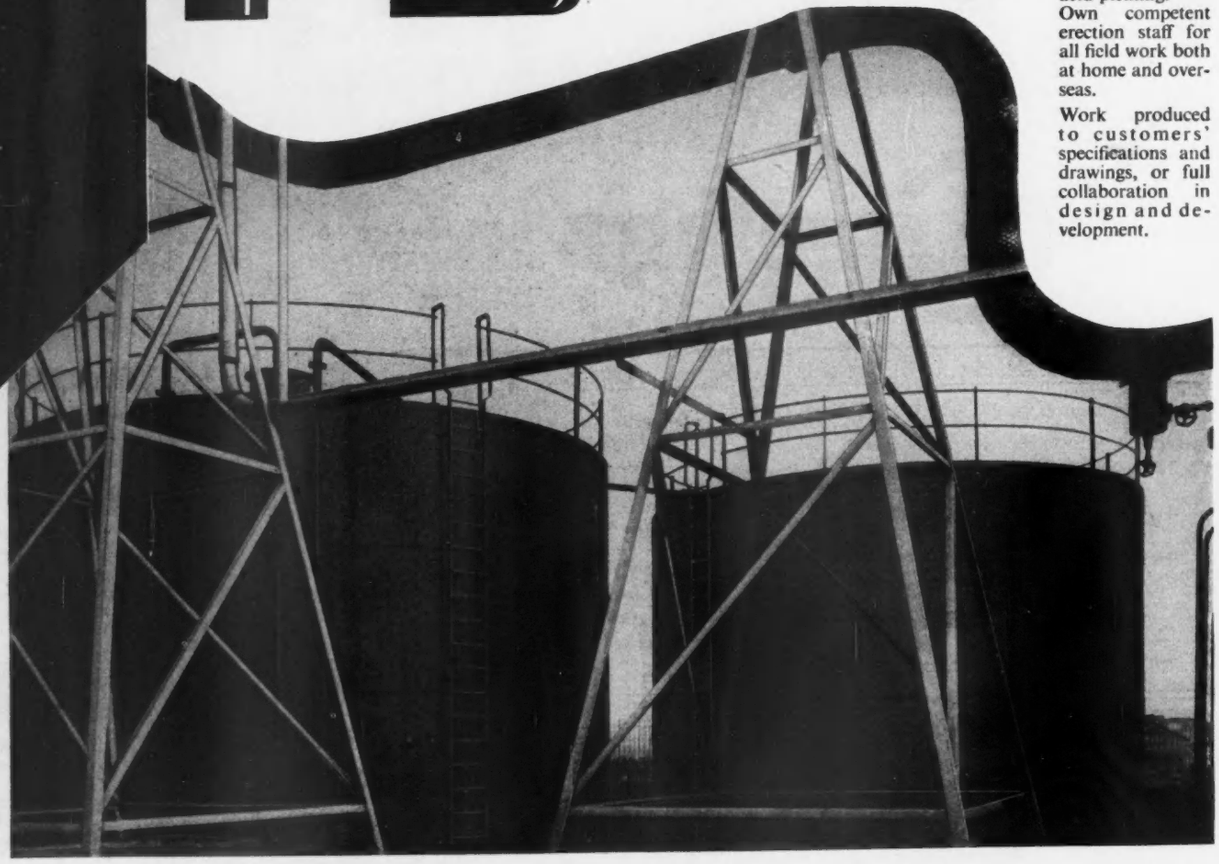

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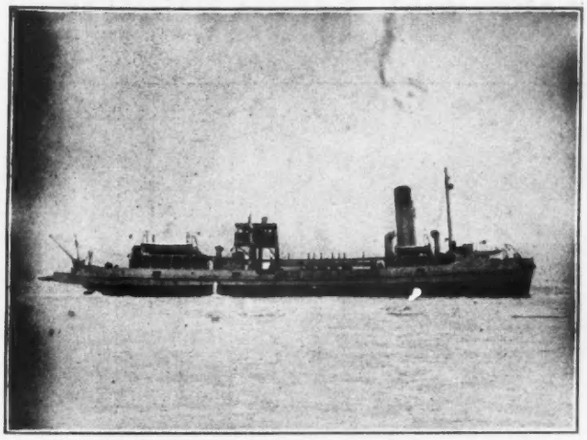

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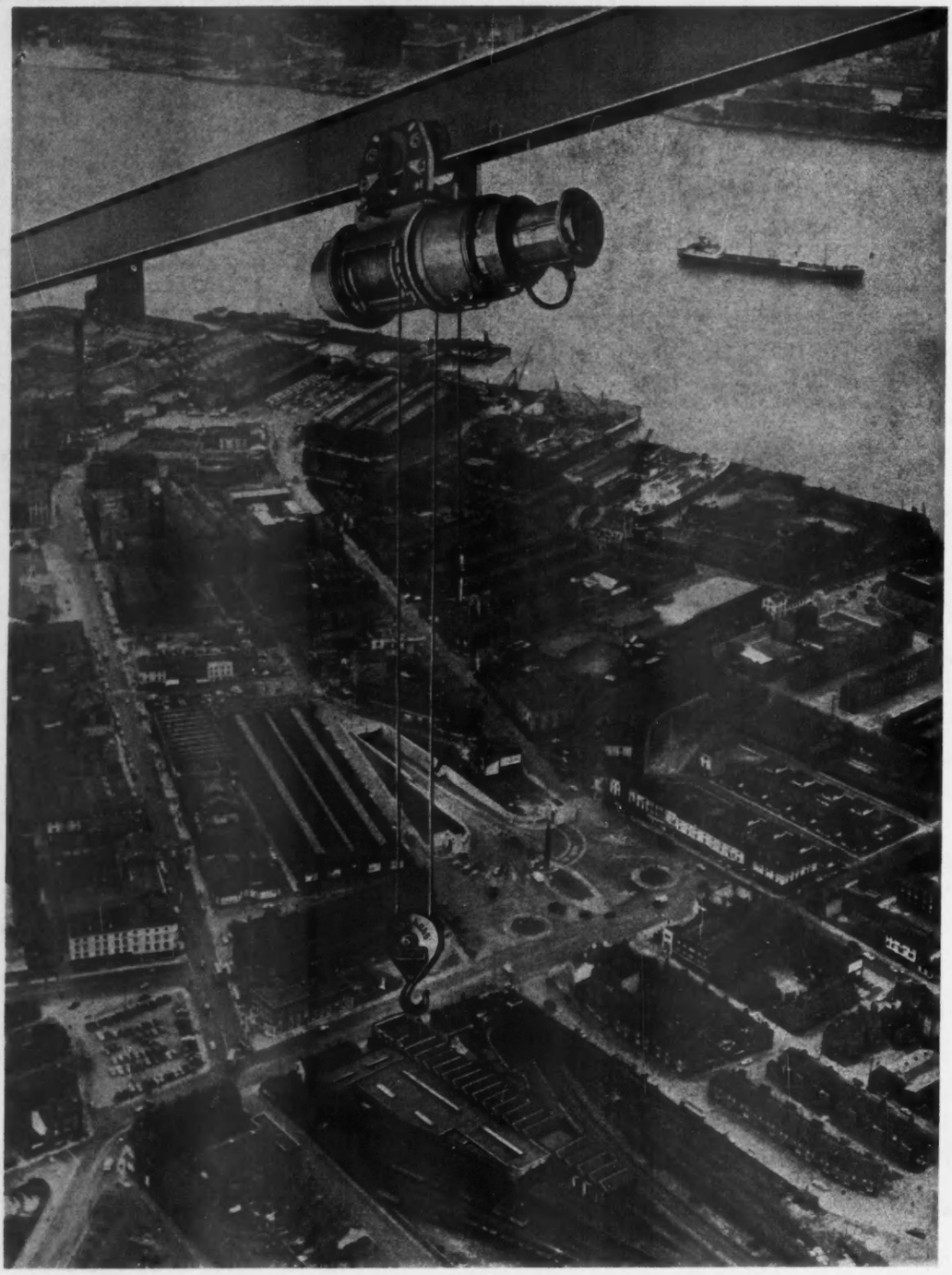

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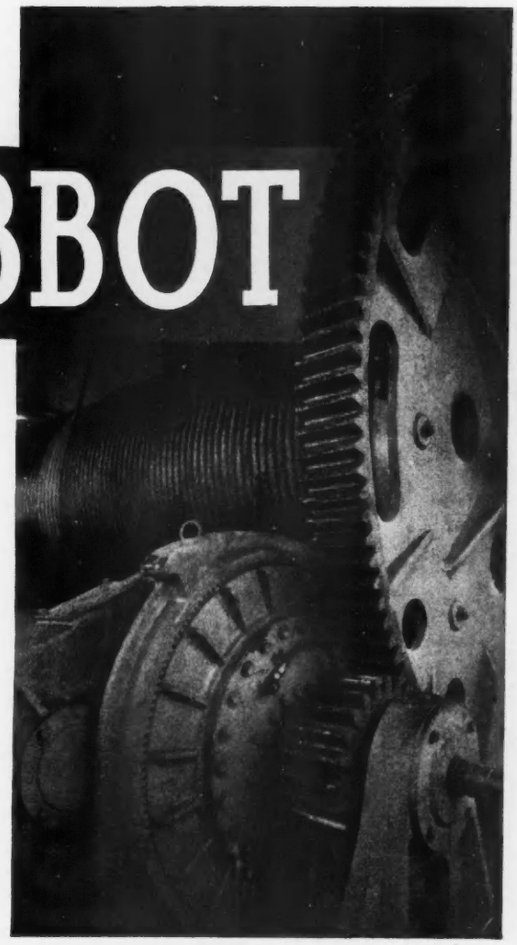

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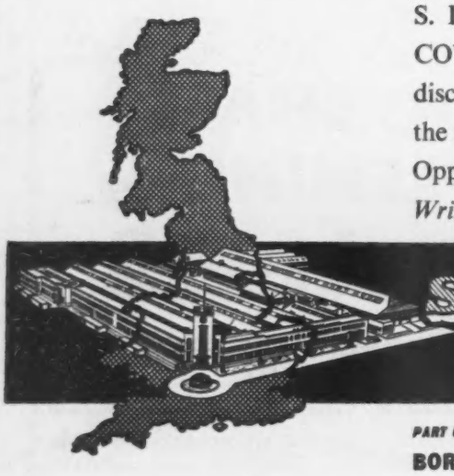

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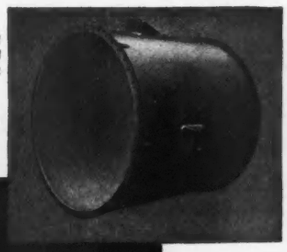

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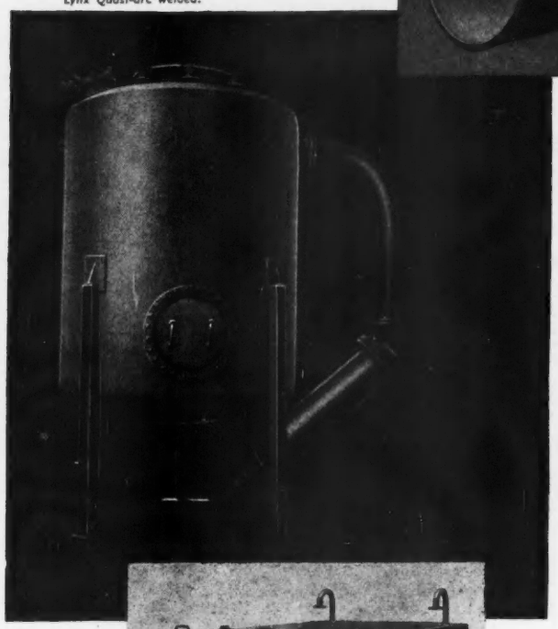

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Clarks offer you a unique combination of the most advanced equipment and methods with a century-old reputation for high craftsman standards on every type of fabrication work.

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All who are interested in fuel economy and compliance with the Clean Air Act, 1957 should send for details of this new approach to the problem of Smoke Control.

UNIT TYPE CCSI.

This unit enables you to comply with the Clean Air Act, 1957 and is available for any size of flue or stack up to 40 feet. The 10in. Meter gives continuous indication of smoke density in units of percentage obscuration. An alarm set-point gives visual and audible warning of excess smoking.

Price £59 per set

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This unit is similar to the Type CCSI but does not include the Meter. It does however give visual and audible warning when smoke exceeds a pre-set level and thereby enables you to comply with the Clean Air Act, 1957.

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RECORDERS.

A variety of recorders are available for use with the photo-electronic smoke density indicator and smoke alarm units.

* ***No valve amplifier required***
* ***12 months guarantee***
* ***An all-British product***

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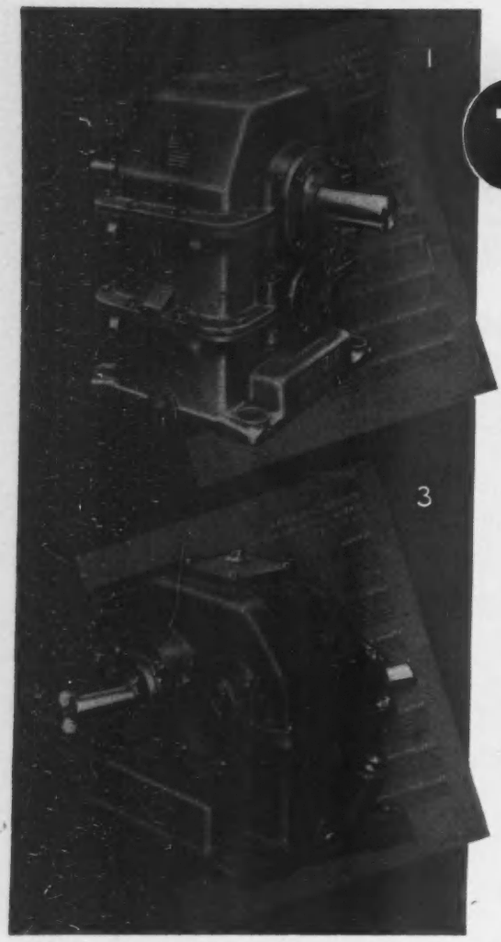

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Co-axial type spur or helical gear units. Types DRCO and DRCV. Double reduction ratios up to 50 to 1. Single reduction ratios up to 7½ to 1.

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Single reduction spur or helical gear units. Type SR-N, narrow Ratios up to 5 and 10 to 1.

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Double reduction spur or helical gear units. Type DR horizontal. Ratios up to 60 to 1.

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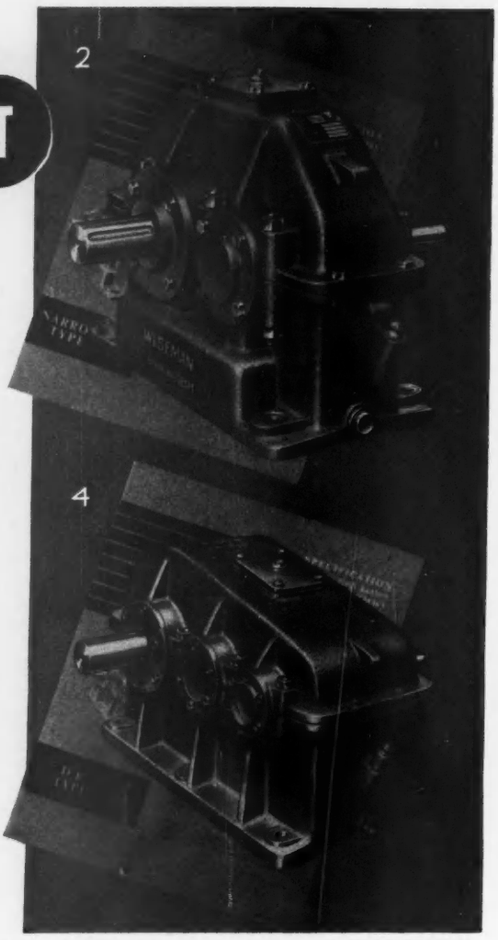

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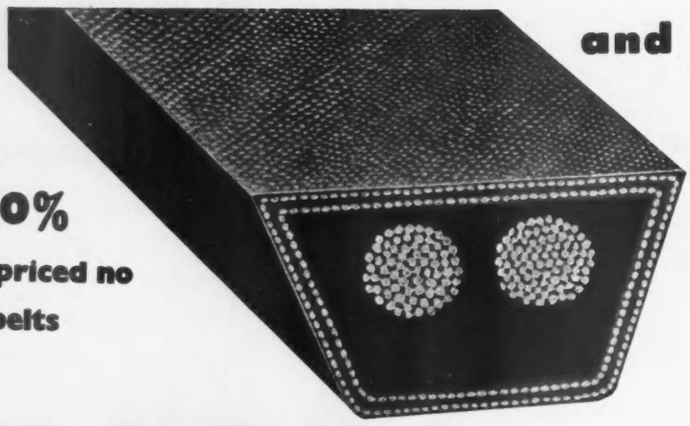
between this  and any other V-belt

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A new range of totally-enclosed fan-cooled motors... Smaller, lighter than previous T.E.F.C. standards... Frame sizes identical with ventilated motors of the same rating... The T.E.F.C. range of Series 5 A.C. motors made by...

Electrically these motors conform to B.S. 2613:1957 Class E insulation. Dimensions conform to a new B.S. draft specification and are the same as those of Series 5 ventilated motors (B.S. 2960:1958). These T.E.F.C. motors can be supplied interchangeable with N.E.M.A. totally-enclosed, fan-cooled motors of the same rating.

The first batch—ratings from 1 to 7½ h.p. at 1400 r.p.m.—can be ordered now. The remainder of the range, 10 h.p. to 40 h.p. at 1400 r.p.m., will be available during the Spring.

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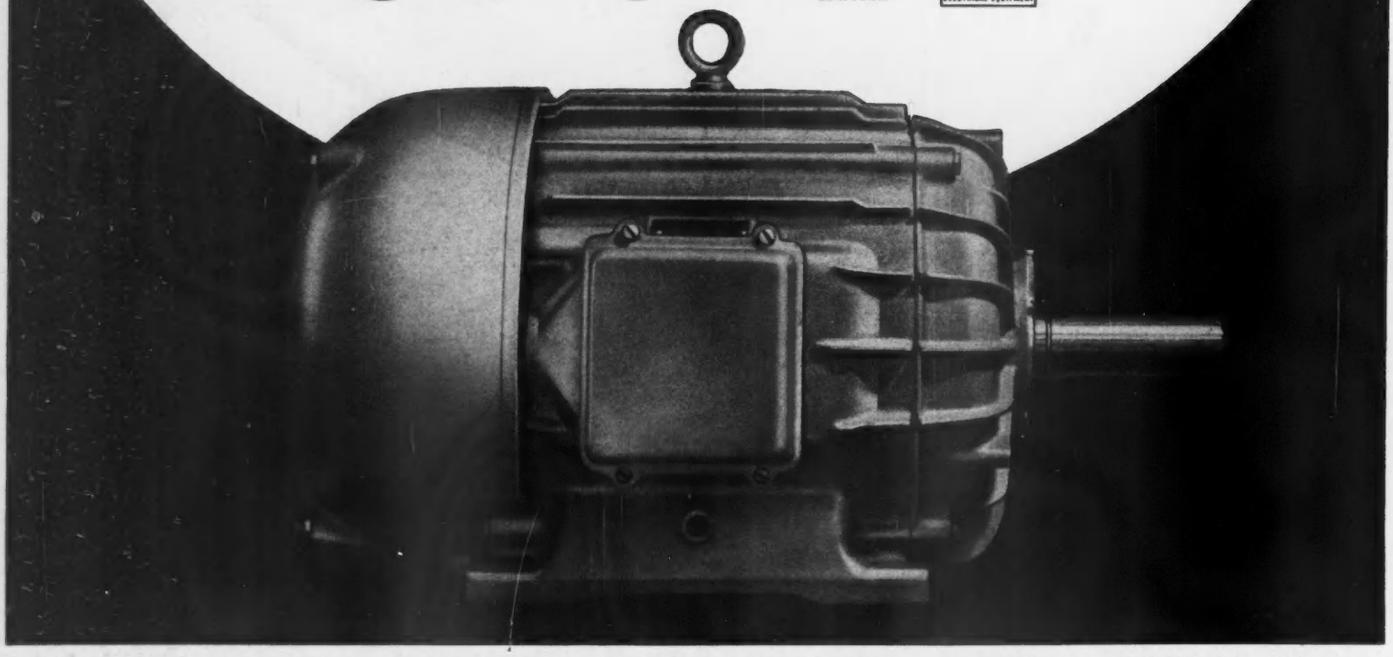

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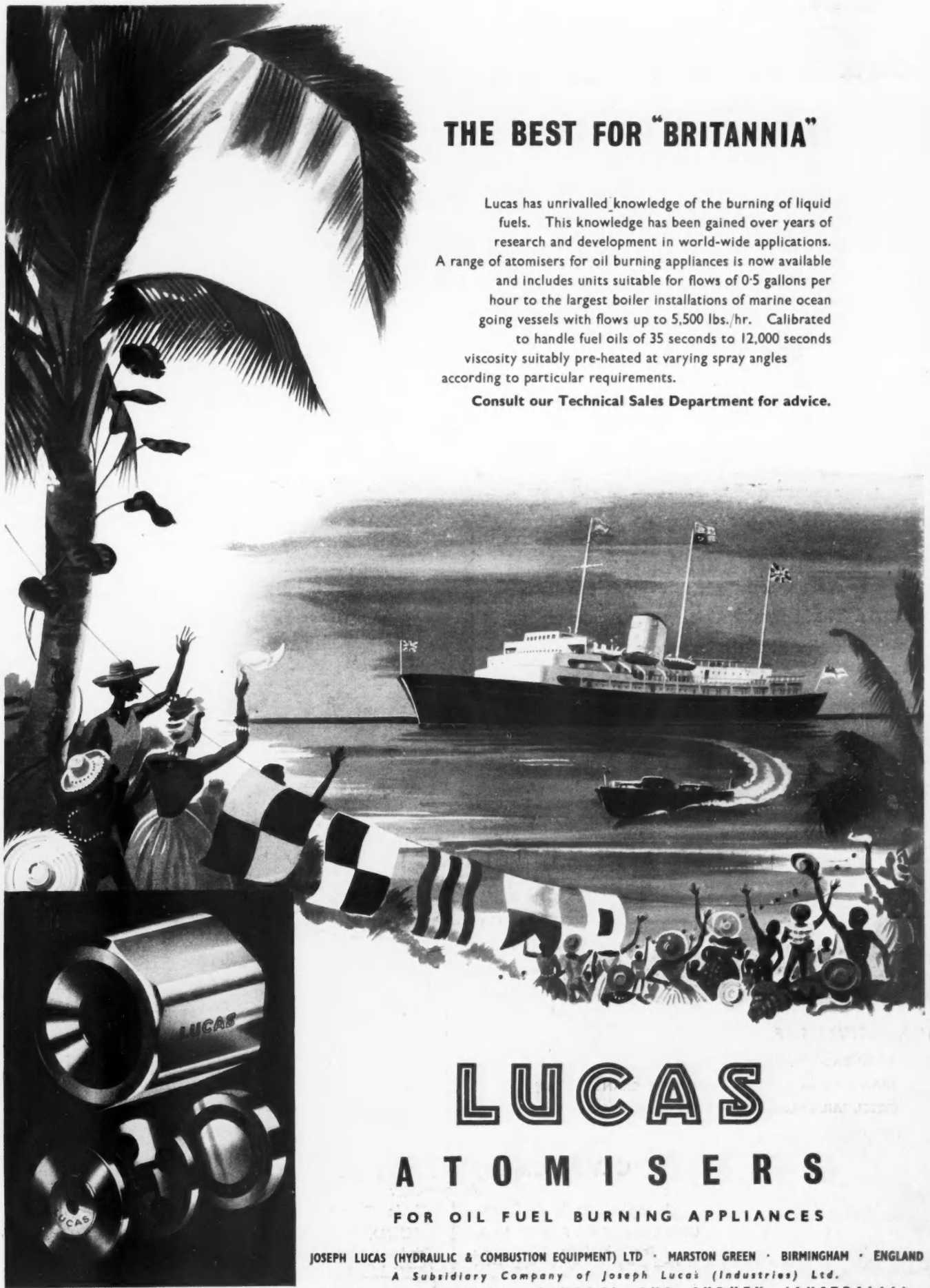

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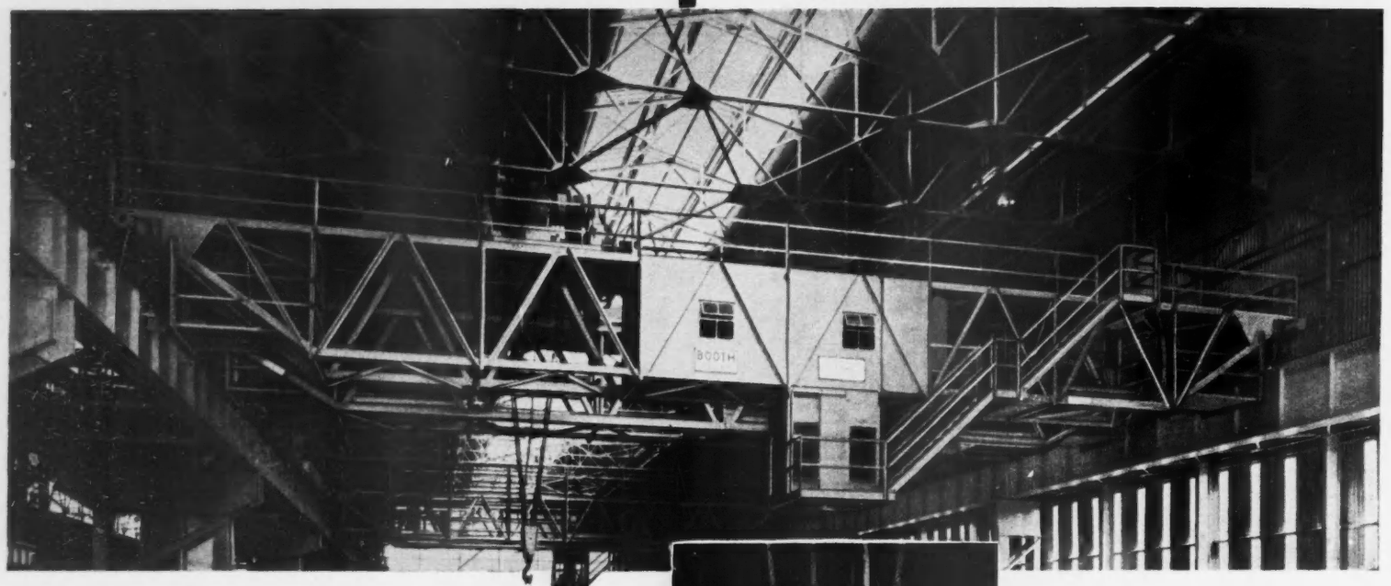
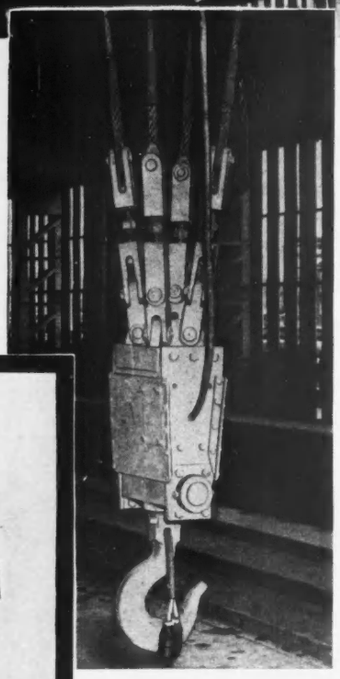
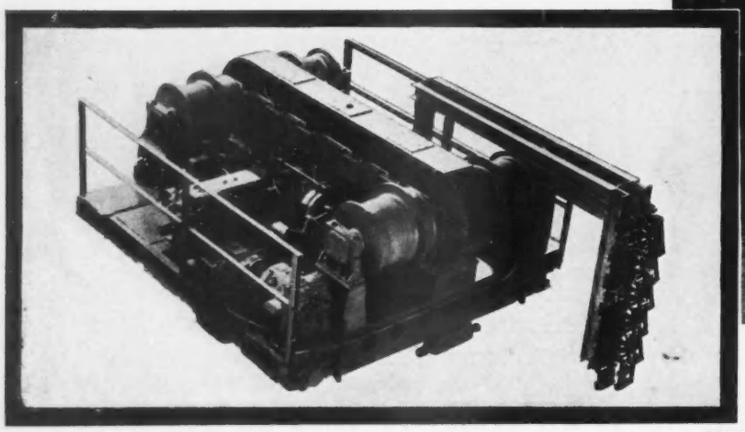


(ABOVE) Clyde-Booth four point suspension electric overhead travelling magnet crane at Messrs. Colvilles Ltd., Ravenscraig Works.

(RIGHT) The hook with slip-ring gear for the magnet, showing attachment of the four ropes.

(BELOW) The special four barrel crab.





With the introduction of higher rates of acceleraton and braking on traversing and long travel motions, in order to get the maximum output from overhead travelling cranes, magnet cranes with multiple splayed ropes are finding favour.

This type of suspension effectively damps out swinging of the load due to acceleration and braking forces.

Clyde-Booth cranes of three and four rope suspension design are produced to meet these requirements.

Please ask for information on our range of cranes.

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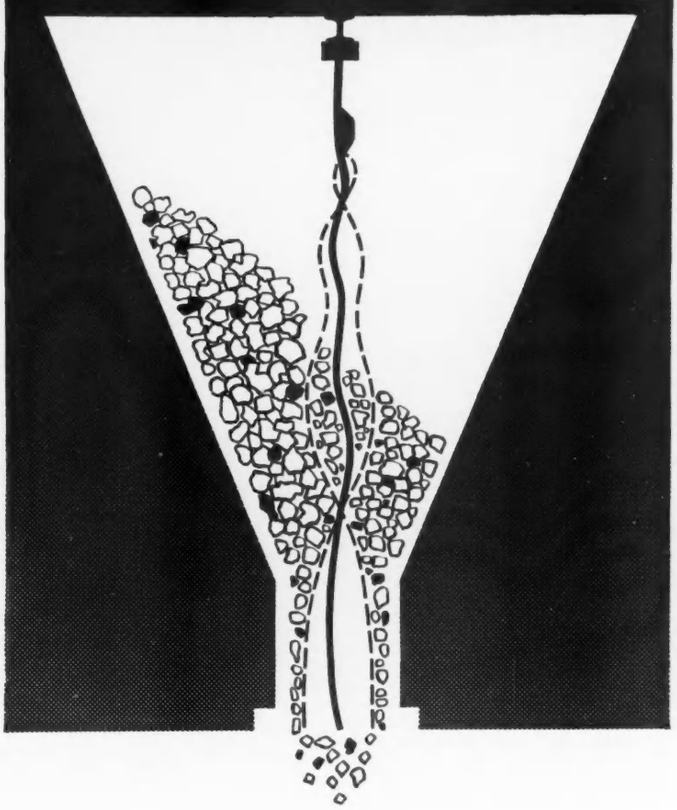
Efficient Bunker Discharge



The problems of efficient discharge of material from large storage bunkers where external vibration is impractical is simply overcome by the installation of the new Sinex Internal Bunker Vibrator. The device comprises a Sinex rotary electric vibrator attached to a steel reed which hangs down into the bunker. The unit is suspended from a rolled steel joist and anti-vibration mountings protect the hopper structure itself. Maximum amplitude occurs at the tip of the reed or at the point where stoppage has built up, releases the material and ensures a smooth, free flow. Sinex Internal Bunker Vibrators are completely reliable, the power unit being readily accessible and causing no obstruction to the material inside the hopper.

Sinex

INTERNAL BUNKER VIBRATOR

A new range of Sinex rotary electric vibrators has been designed to eliminate disadvantages normally associated with this equipment. Available in four sizes providing centrifugal forces up to 300, 500, 1,960 and 7,600 lb. respectively.

Send for relevant details and information sheet.

Opportunity for distribution rights are still available in some areas.

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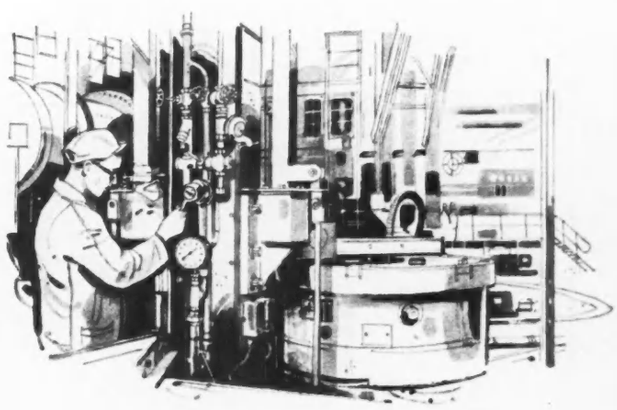
Where hot water is provided from a storage system there is a waiting period when production starts, for the water to heat up in the storage tanks.
With Leonard Steam Water Mixers there is no waiting period. Hot water is available as soon as the steam is turned on.

Do you use cold water when you would like to use hot?

When vegetables are cleaned for canning they are washed in a running stream of water. If the water is too cold the girls' fingers get numb and their production slows down. If it is too hot the vegetables are spoilt. A Leonard Valve looks after the temperature, the girls' fingers and the vegetables.

How would you raise the temperature of a spray very gradually from cold to 120 degrees?

Leonard Valves fitted to the sparge pipe on a cloth scouring and milling machine enable the scourer to vary the temperature to suit the work and to make changes in the temperature during the process gradually, giving a cleaner scour and a better finish.



These are specific examples. Your use of Leonard Thermostatic Steam Water Heaters will probably be different. Write for help. (Our folder H/6)

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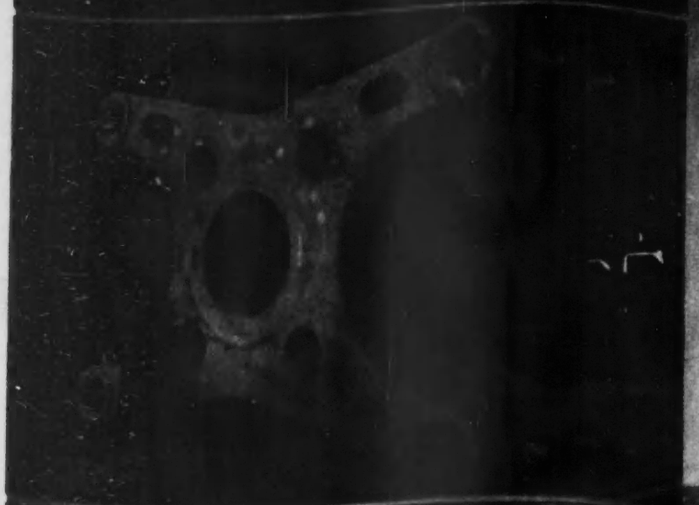

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In the past, the Company's moulding pits and forging presses have produced structural and engine components for many of the world's greatest ships. Today they are making their own invaluable contribution to the expansion of Britain's heavy industrial capacity.

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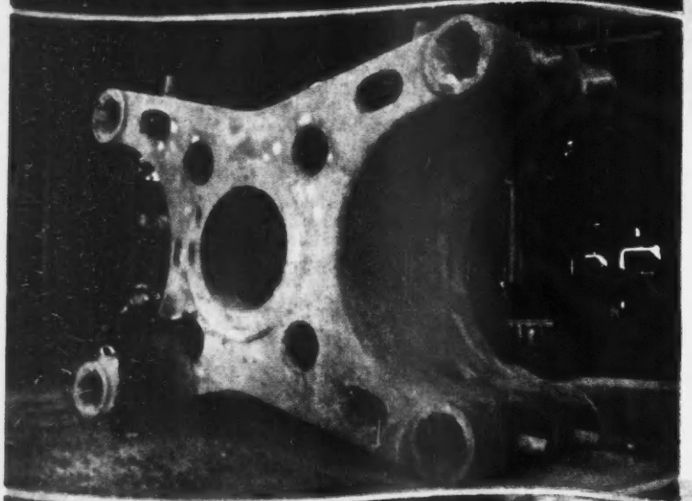

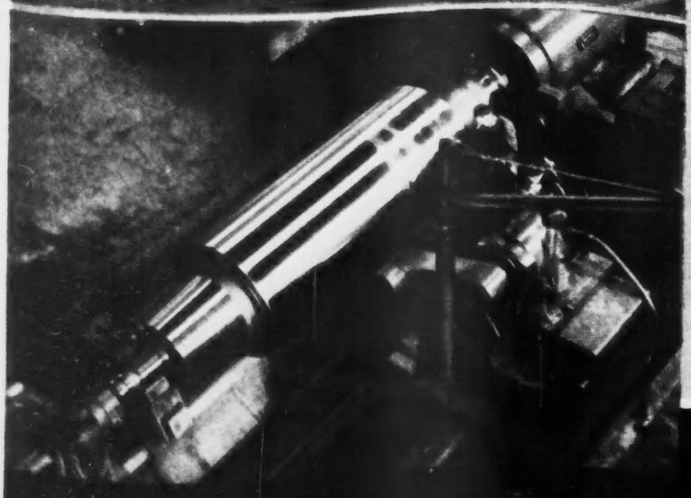

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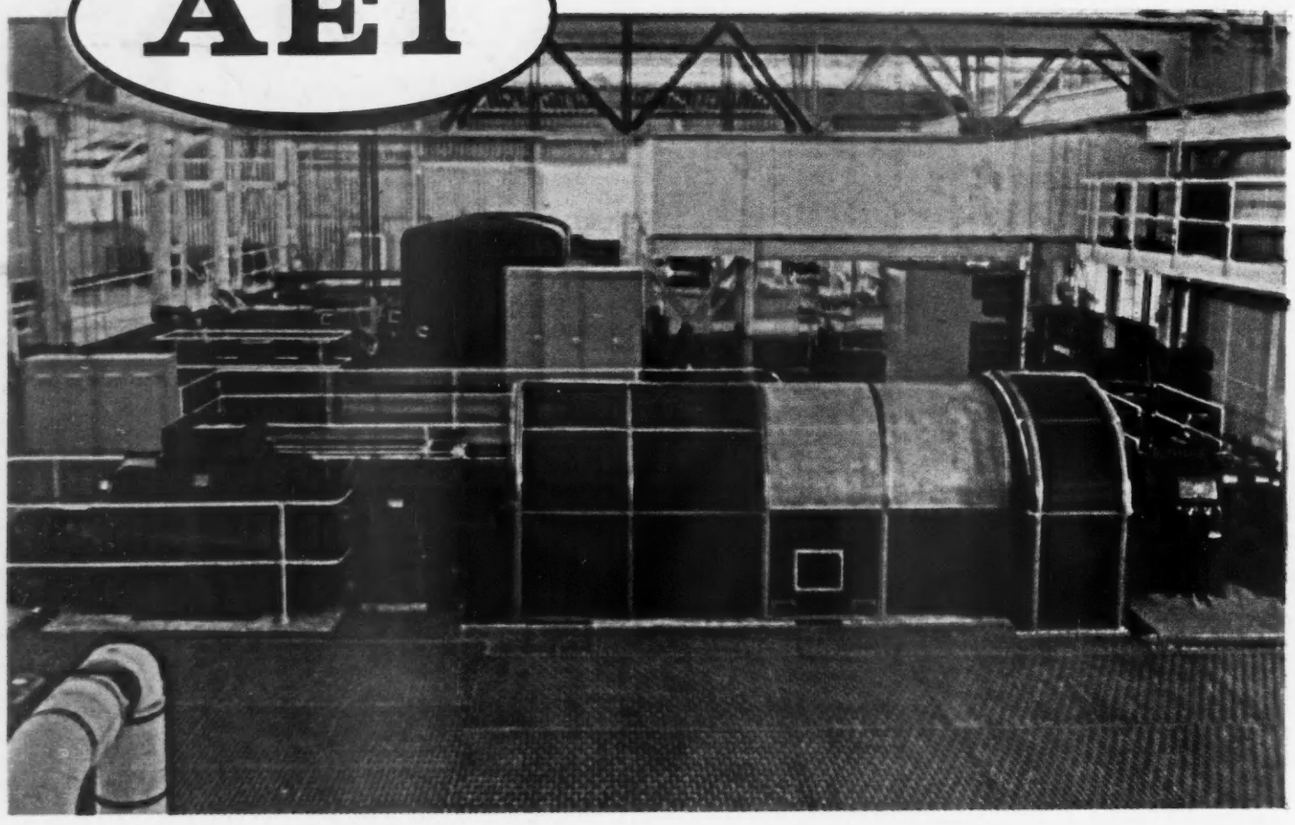

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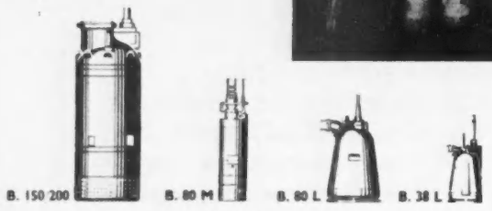

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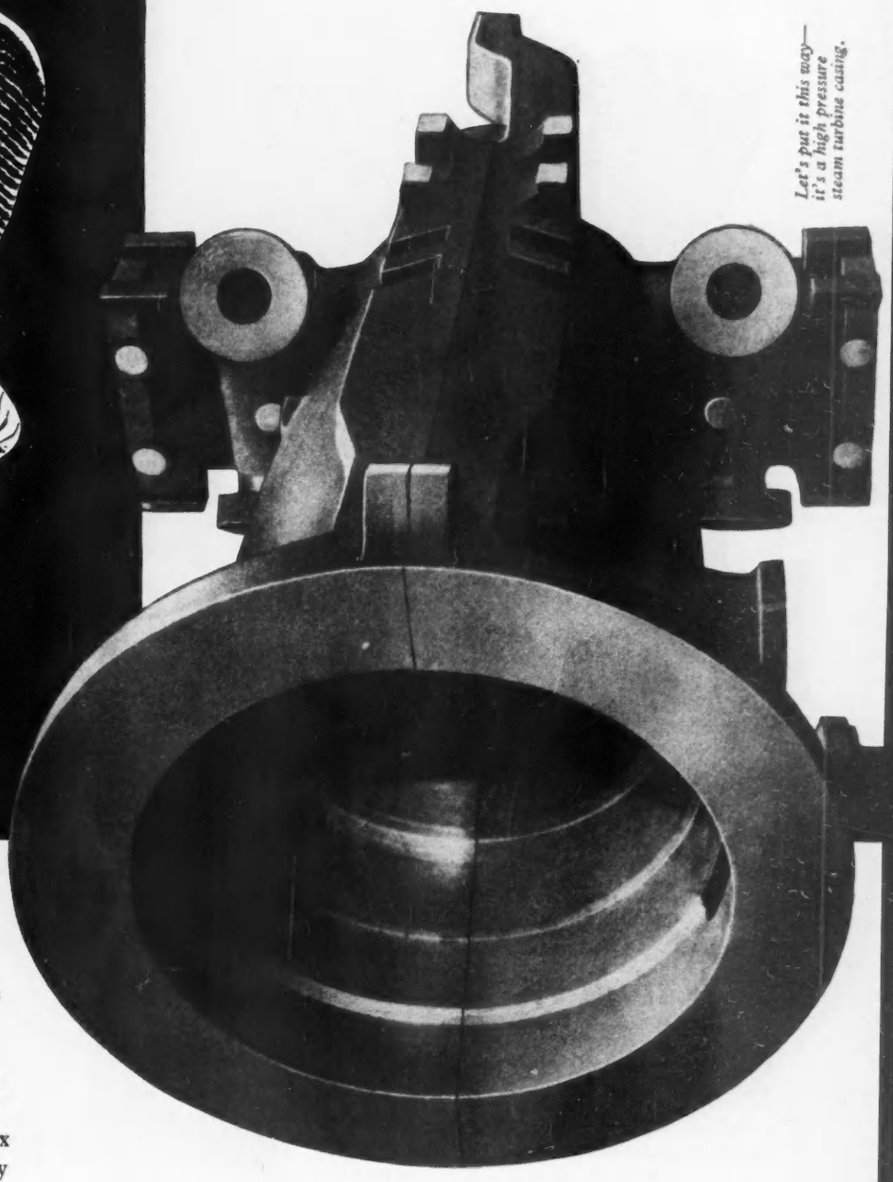

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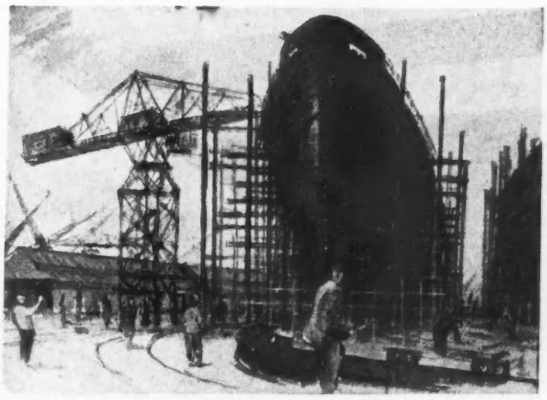

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D19

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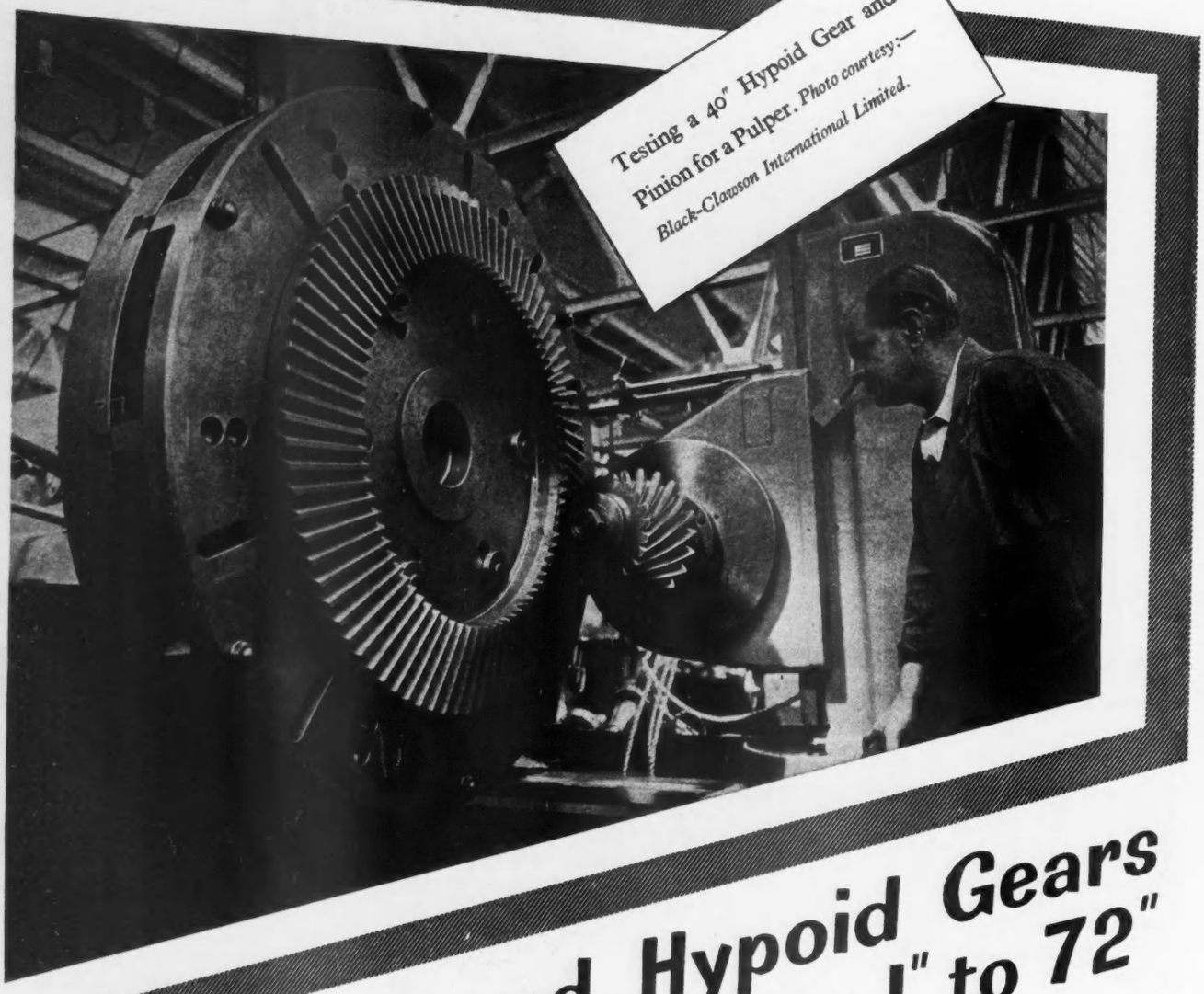

Testing a 40" Hypoid Gear and Pinion for a Pulper. *Photo courtesy:— Black-Clawson International Limited.*

Spiral Bevel and Hypoid Gears from 1" to 72"

Spiral bevel and hypoid gears offer many advantages for right angle drives where high efficiency and smooth, silent running are required.

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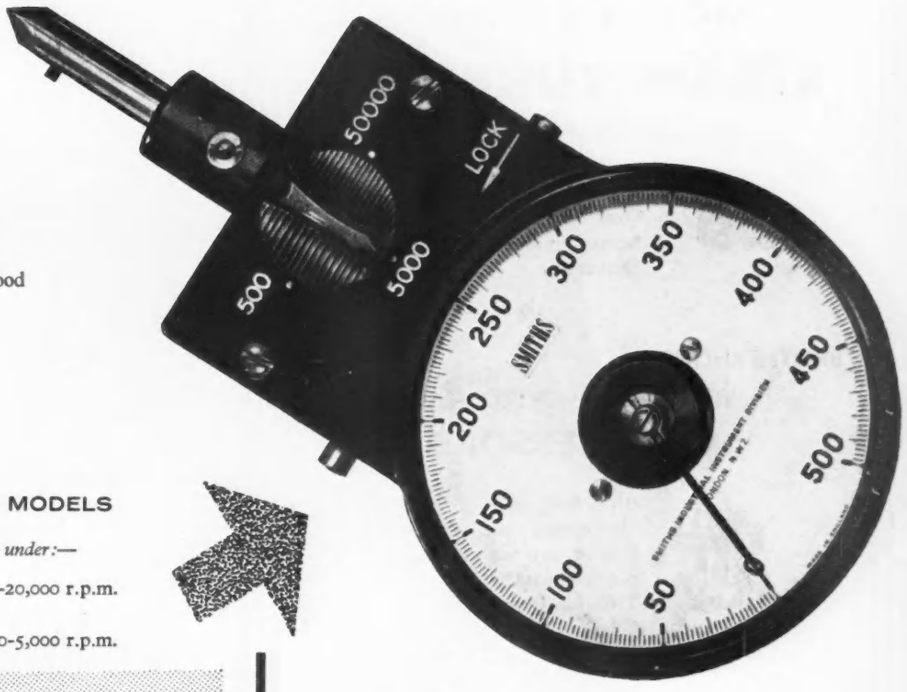
SMITHS for Good Measure



To Industry, the name SMITHS has a world of meaning. It includes a reputation for Good Measure, good measure in the sense of the long-term accuracy of their industrial instruments, good measure in terms of the service offered by unrivalled research and test facilities.

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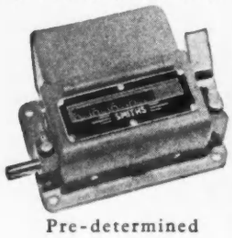

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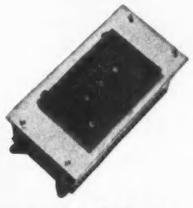

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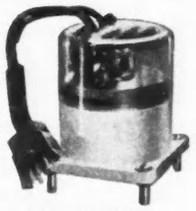

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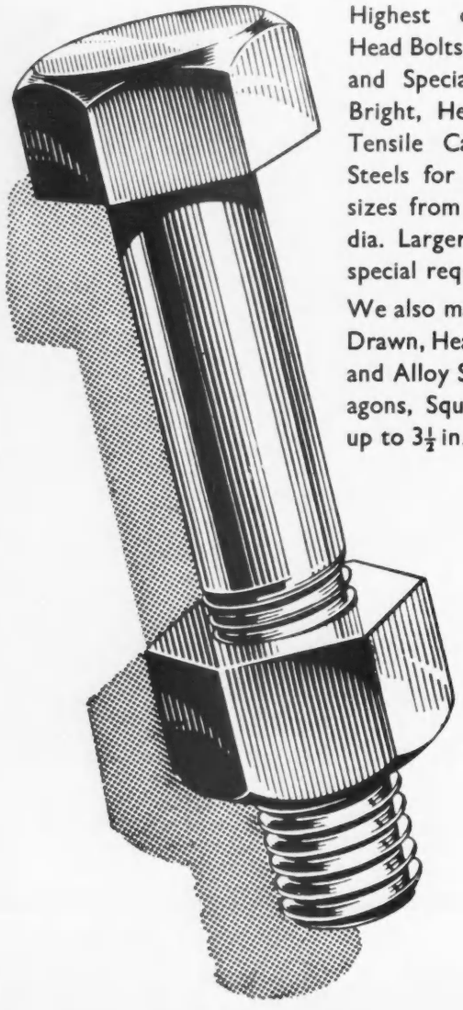

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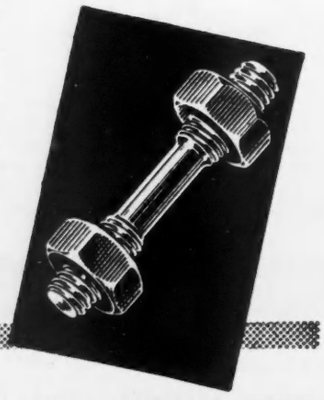

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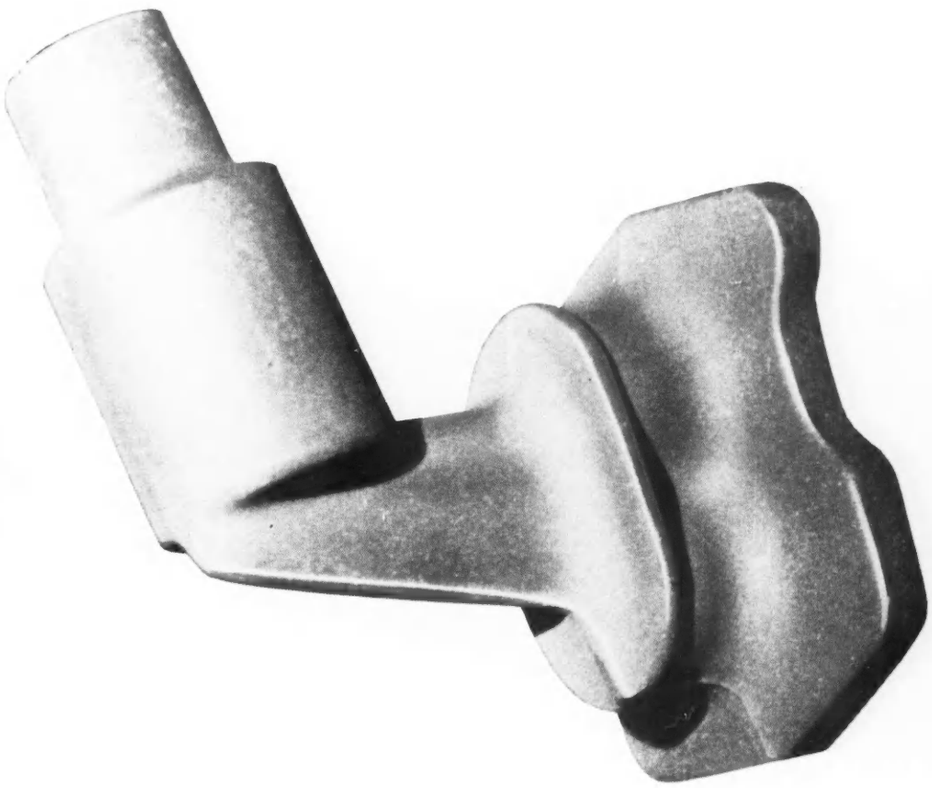

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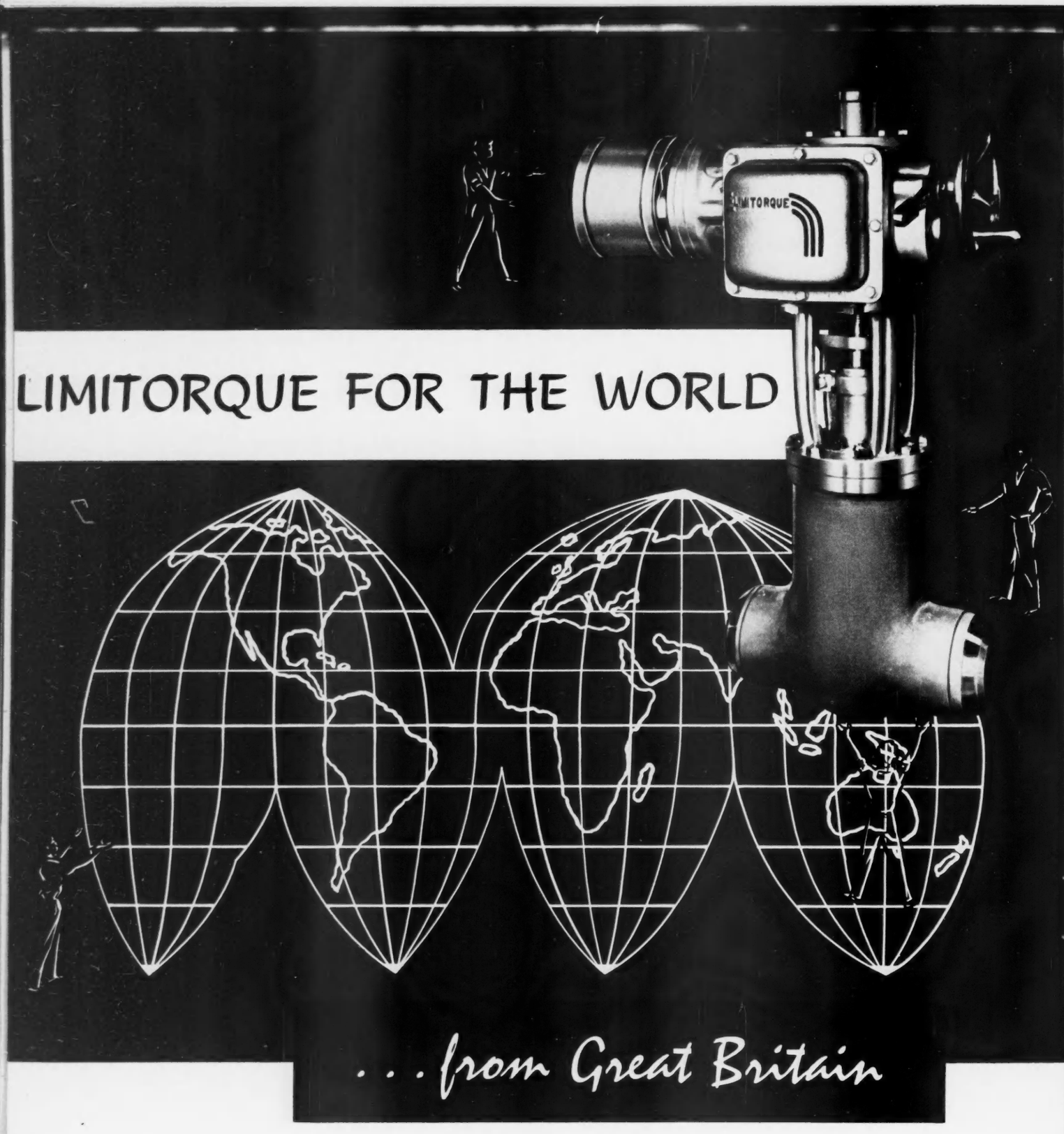

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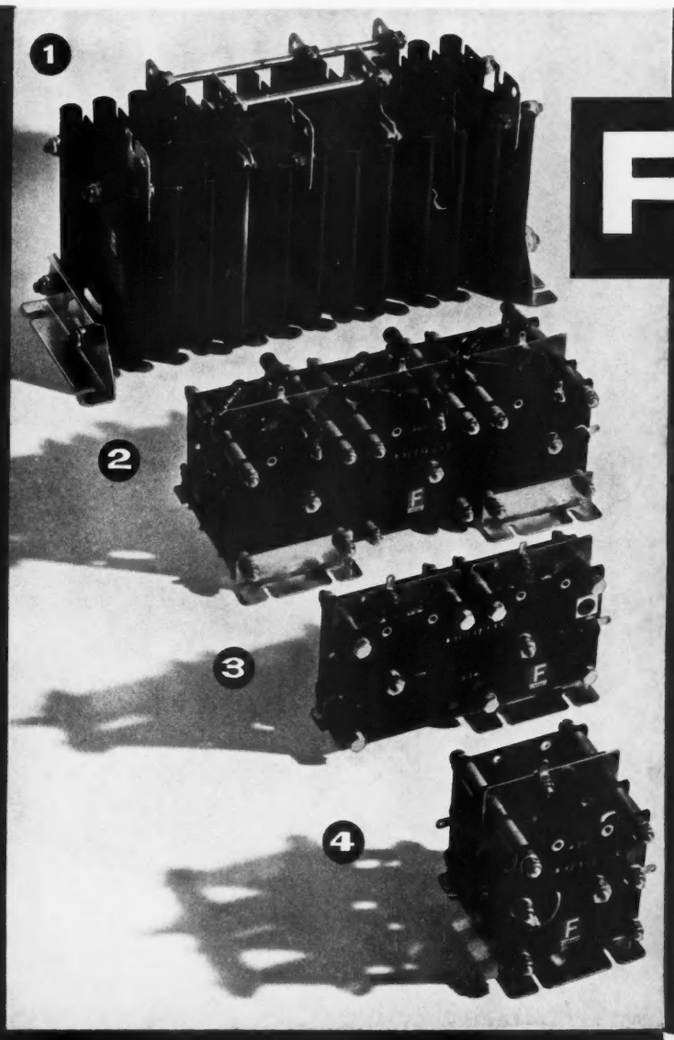

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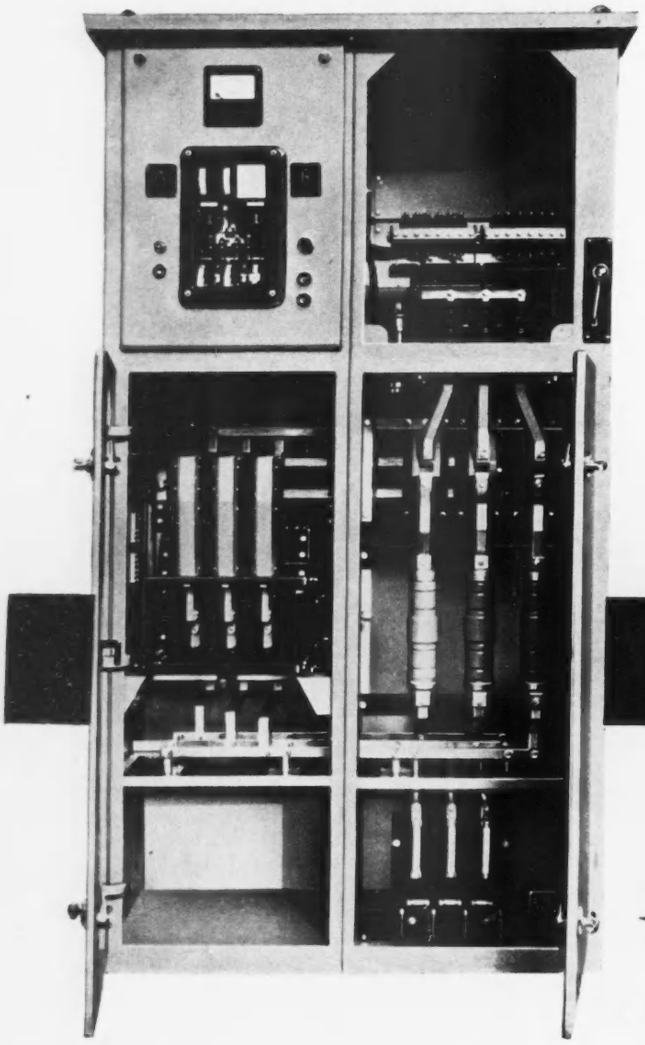

- ★ Air-break contactor rated at 150 amperes. Breaking capacity of 1,300 amperes at 3·3 kV, 0·25 power factor.
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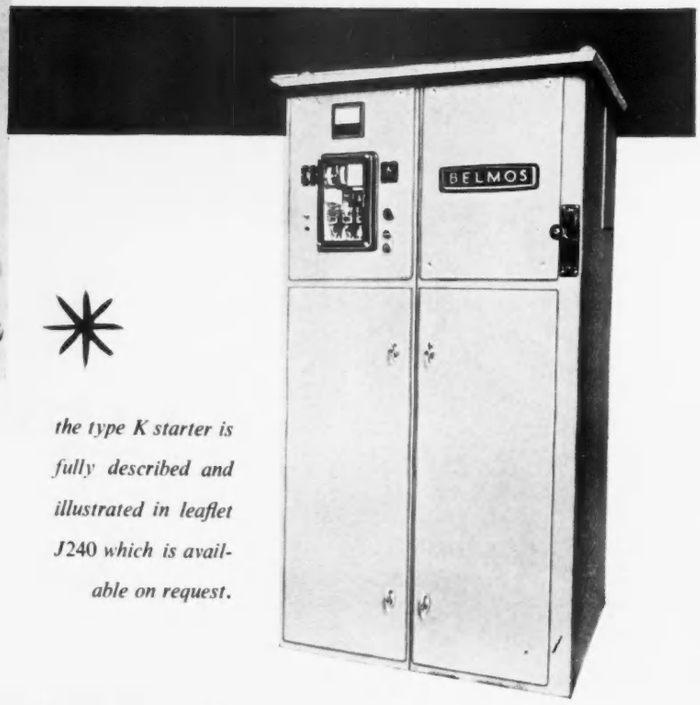

✶ *the type K starter is fully described and illustrated in leaflet J240 which is available on request.*

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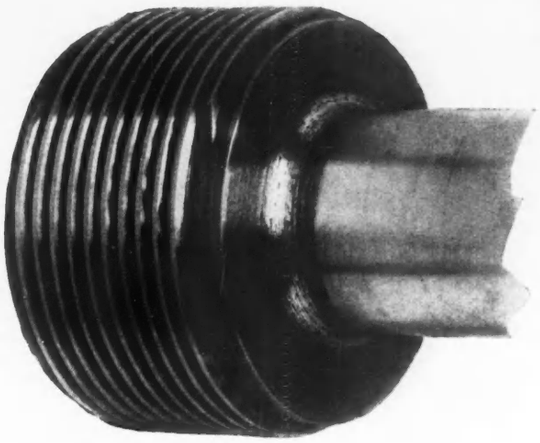

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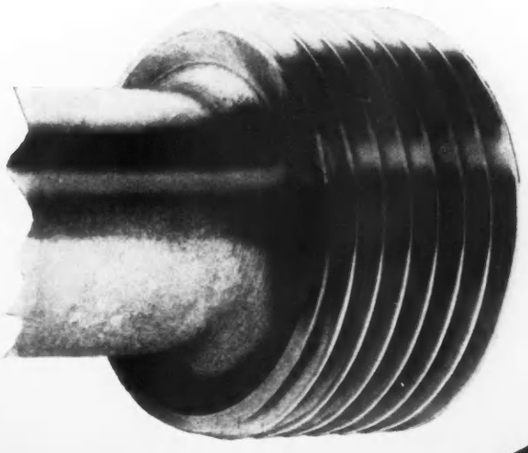
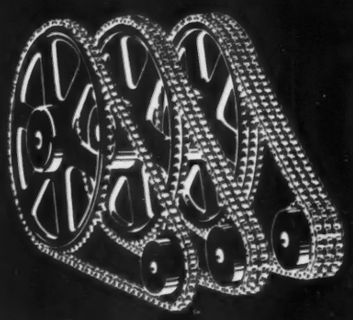
These unretouched photographs of the work from a thread grinder show (top) before and (bottom) after the grinding wheel was converted to a Renold chain drive.



FOR A BETTER DRIVE FIT A CHAIN



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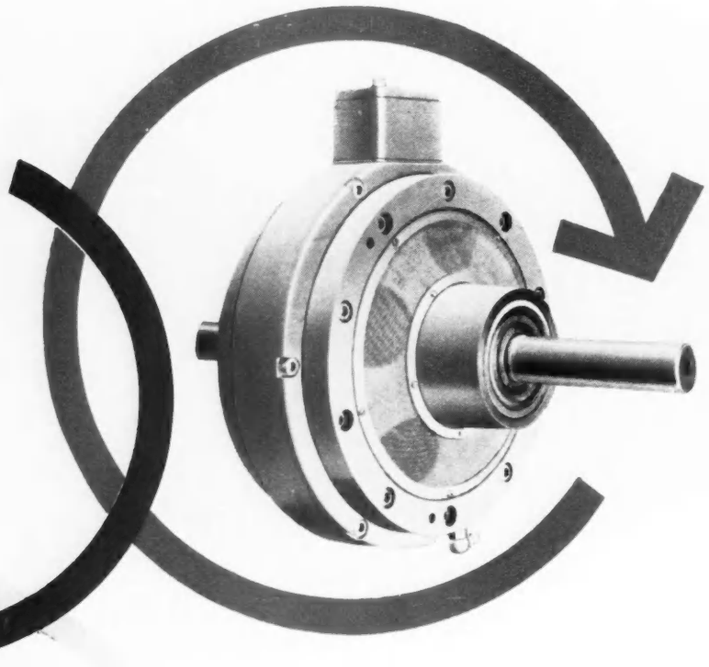

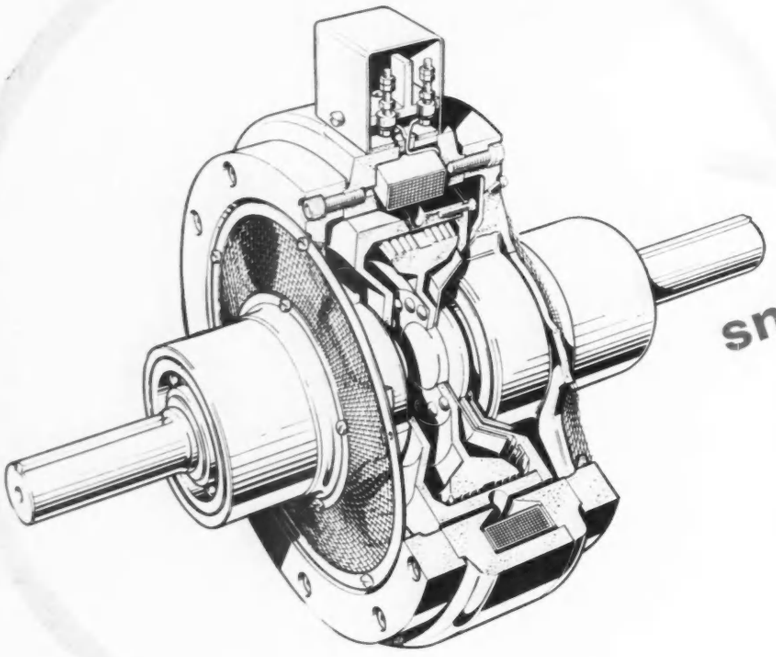

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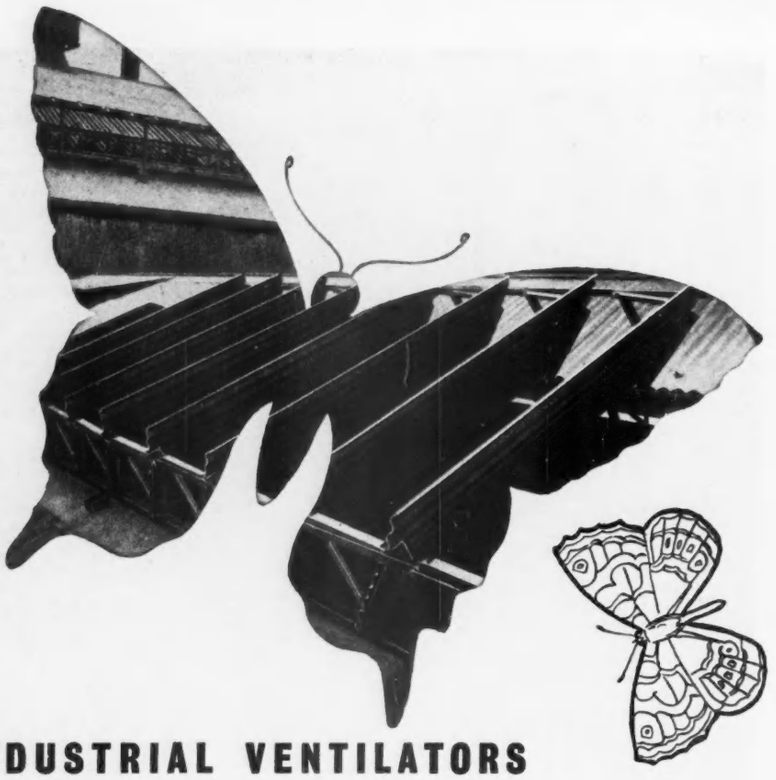

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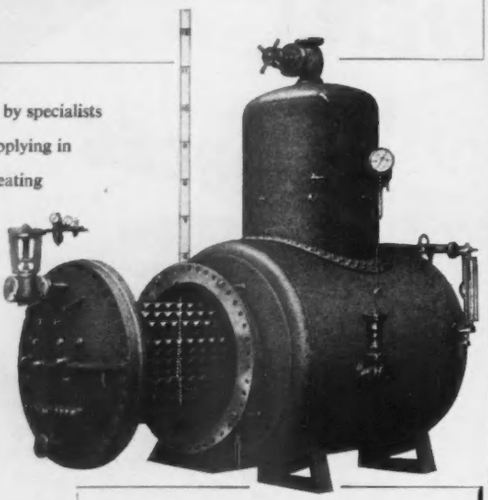

Illustration shows a Generator designed to generate 7,000 lbs. of steam per hour at a pressure of 120 p.s.i. using as the primary heating medium, steam at a pressure of 300/350 p.s.i. and temperature 750 degs. F.

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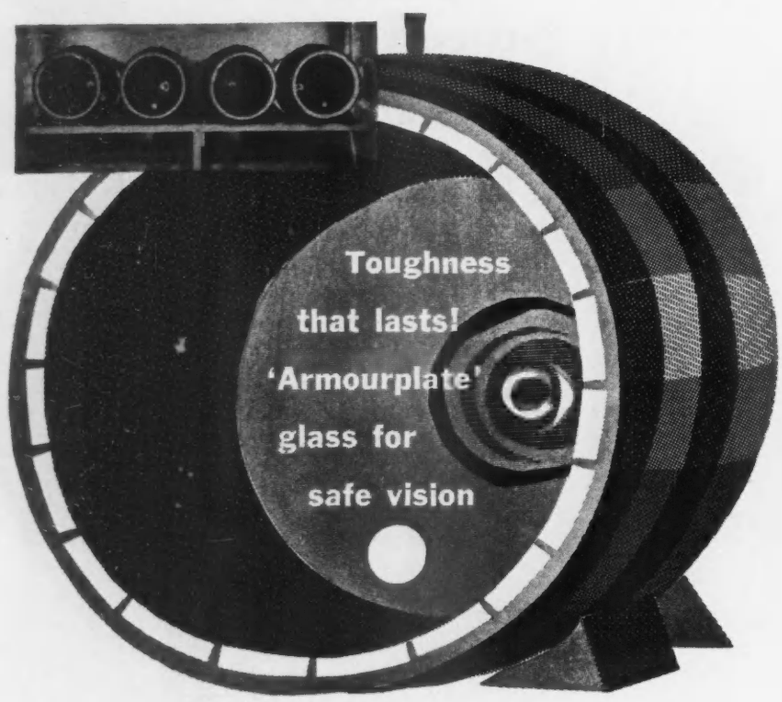

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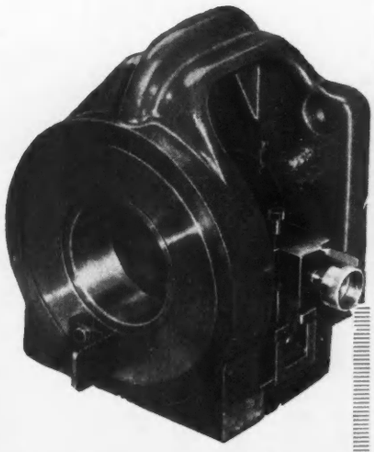

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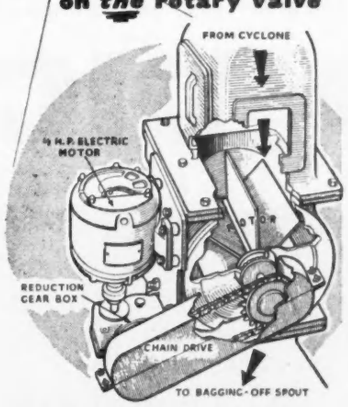

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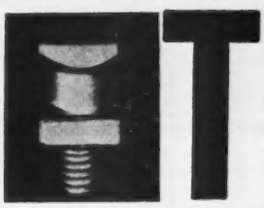

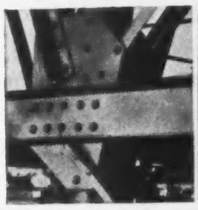

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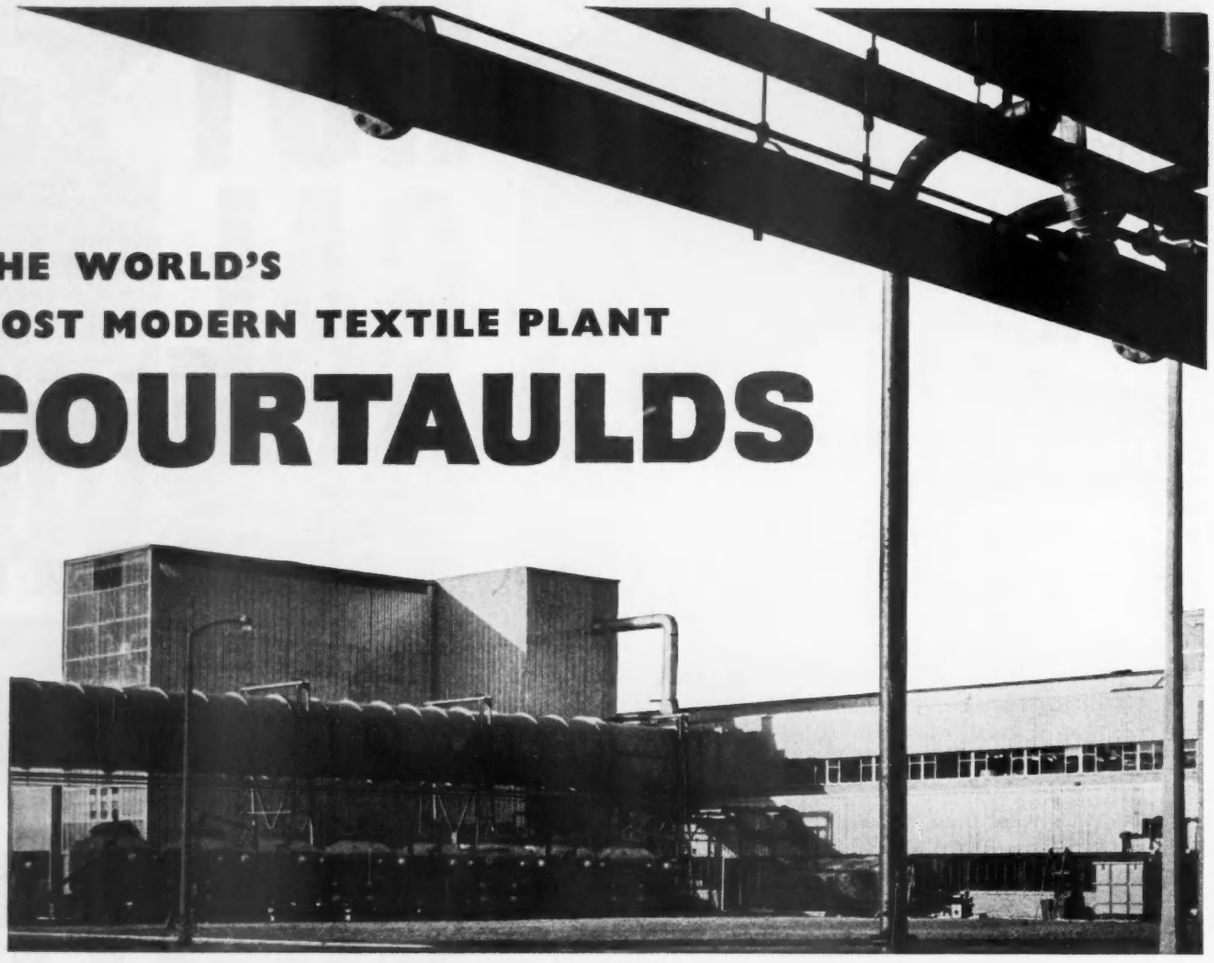

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ENGINEERING Impact

of Machine Tool Improvement

The sharp rise in the new export orders for machine tools announced towards the end of last month was matched by the increase in home orders, which suggests that the boom conditions in the car industry and other producers of consumer durables are working through to the tool making firms.

The export orders rise was from the low figure of £376,000 in August (it had been £1,923,000 in July) up to £2,460,000 in September, the latest month for which figures are available. In September, 1958, the new export orders had amounted to only £1,055,000.

At home the orders rose from £5,467,000 in August, which was itself more than £2 million up on July, to £7,744,000 in September. The position of the order books at the month end was not so stimulating. The export order book at the month end was much the same as in 1958, above £15 million. At home the order book at the month end, £37 million, was still down £6 million on the end of September 1958, £43 million. But the rate of orders is markedly up, even allowing for the resumption of work after the holidays, and with the multi-million pound schemes of development in the car industry, diversification in the aircraft firms, and the only now developing recovery in heavy engineering a continuation of the improvement seems probable.

Argument

Encouraging as the industry may find these figures they are not likely to still the argument over the way the machine tool manufacture of the United Kingdom is carried on. Mr. W. J. Morgan, adviser to the Machine Tool Trades Association, fired off some accurate rounds at the earlier BBC talk by Professor Seymour Melman, when he was interviewed on the BBC "Workshop" programme.

Mr. Morgan's interviewer slipped from Professor Melman's statement that the Russians, with their mass production methods, could export large quantities of tools, into asserting that they were already doing so.

Mr. Morgan knocked this misapprehension down and went on to doubt whether the Russians would be in a position to export mass-produced machine tools for a long time yet. Those being made by mass production were three or four types, out of many hundreds of types, and many of these the Russians did not make at all and had to import. All that were made by production line techniques were needed for their own consumption. It was by organising that consumption and giving it no option but to use certain tools, claimed the MTTA adviser, that the Russians had been able to bring in these methods.

In the West, producing tools for a vast number of free users, it was obviously not possible so to organise the demand.

Mr. Morgan's last point cannot be denied, but for whatever reason the Soviet authorities have been able to achieve this flow production one of its effects that the Western industry will presumably be finding ways to meet is that, having done it, they are in a position to turn to the developing areas of the world with tools to which those countries could shape their expansion.

On research spending the BBC interviewer was armed with the figure of a recent survey that less than one per cent of the industry's turnover went into research. Mr. Morgan returned on this the interesting comment that this figure might well not include the money spent on developments in the industry since he thought manufacturers' development costs were swallowed up in production costs.

In the machine tool industry of this country where so often the machine is made to do a particular job the development costs may well be not very easily separable from other costs, but it would have been strange if none of the manufacturers replying to the questionnaire attempted to make some estimate.

Steel Peace at a Price

Three weeks before the date on which it could have started again, the United States steel strike has been brought to an end with mutual congratulations. £215 million has been added to the steel companies' costs by their last concession.

There is no statement from the companies that they will be able to keep the price of steel steady. In Britain the steel industry is a model of management-union consultation. There is a long unbroken tradition of freedom from the disputes which periodically disrupt the American industry.

The cynical may construe the long refusal of the steel firms to compromise as a willingness to see steel stocks used up over a period in which labour costs had taken themselves off the books. The hardship which the men met before the Taft-Hartley injunction compelled the return to work, for the 80 days that would have expired on 26 January, was relative by European standards. The credit of the strike-experienced shop keepers in the steel towns was as long as their confidence. Back at the plants, and with a message of peace, prosperity and lasting happiness from their president, Mr. David McDonald, the steel workers will not be overlong in getting out of the red.

A feature of the last weeks of negotiation has been the intervention of Mr. Richard Nixon, now the Republican's unchallenged hope for the next presidential election. Many times the negotiators met at the vice-president's home. Towards the end he was only able to keep in touch by telephone, but the Labour Secretary, Mr. J. P. Mitchell, openly stated when peace was announced; "we would not have had a settlement" without Mr. Nixon.

So the dispute that has lost $1,000 million in production, lifted the unemployment figures and decimated the stock position, closes with its settlement boosting the reputation of the Republican candidate. Perhaps some hypothetical steelmaster surveying his account sees on the credit side—four more years of Republican administration.

of Prospects for Soviet-American Trade

The question of easing restrictions on British trade with the Soviet *bloc* was urged recently by Lord Boyd-Orr (ENGNG., p. 631, 18 Dec. '59). The same problem, but from the American point of view, has been widely discussed in American trade journals and elsewhere in the past few weeks.

What are the prospects of increased trade between the USSR and America? Will the political talks be followed by an economic summit to arrange trade in washing machines, Cadillacs and samovars? The short answer is that it takes two to make trade, and at the moment American firms are making no moves to get their catalogues translated into Russian. Partly the reasons are political. Cold war and trade just don't go together.

But there are many economic factors involved as well. Trade is a continuous process and markets are built up over the years. Russia alone of the great industrial powers has never played a large part in world trade. When the Soviets need foreign currency to buy electrical equipment or machine tools, they simply come on to the world market with some product of which they happen to have a surplus. In the past two years tin and aluminium have been sold in this way.

Dangerous

The idea of making goods only for the foreign market is not part of their economic outlook. In food and raw materials also the same rules apply. Supplies are erratic and it would be very dangerous indeed for any firm to gear itself to large scale output in the hope of receiving regular shipments from Russia.

In some cases minerals are being produced by undeveloped countries such as India and Pakistan that are receiving American aid. The Americans hold that the best policy is to help these countries to help themselves by buying from them materials produced with their help. And at the present time when foreign aid dollars must be spent on American goods in order to ease the US balance of payments problem, there is little hope of a big switch over to trade with Russia.

On top of the political and economic difficulties there is also the sordid commercial problem of what to use for money. At a time when the Americans are losing gold from Fort Knox rather too fast for their liking, it might be thought that more trade with the world's chief gold producers might be highly acceptable. Here also the snag arises that the Russians like to balance trade with each country separately but rarely use gold for doing so. All told it looks as though the differences in outlook and commercial practices are, for the present at any rate, too great for there to be any strong likelihood of increased trade between America and Russia.

Generating Plant Up 7 per cent

More than 27 million kilowatts output capacity was reached by the Central Electricity Generating Board by the end of 1959.

An installed capacity of 1,775,000 kW, altogether 21 turbogenerators and 23 boilers, was put into 15 stations, five of them new, during the year.

The high point of the Board's year was bringing into service the High Marnham power station on the Trent, a 200,000 kW unit. High Marnham is the largest single unit so far installed by the Board and has a greater output capacity than any other unit in Europe. Its associated boiler has an output capacity of 1,400,000 lb of steam an hour and the turbine stop valve conditions are 2,300 lb per sq. in at 1,050° F. English Electric made the turbogenerator for High Marnham, and International Combustion the boiler plant.

Two other stations in line with the great demands for which the Board is planning were the Blyth A station in the North, with two 120,000 kW units, and Drakelow B in the Midlands with the same capacity. At Blyth the turbogenerator was by Associated Electrical Industries and the boiler plant by Babcock and Wilcox. At Drakelow B, a new station, C. A. Parsons provided the turbogenerator and International Combustion—Foster Wheeler the boiler plant.

and Norfolk Railways into Roads

Is Norfolk to be the place in Britain in which Brigadier Thomas Lloyd, author of the famous lecture on turning the railroads into ordinary roads, sees his plan coming true?

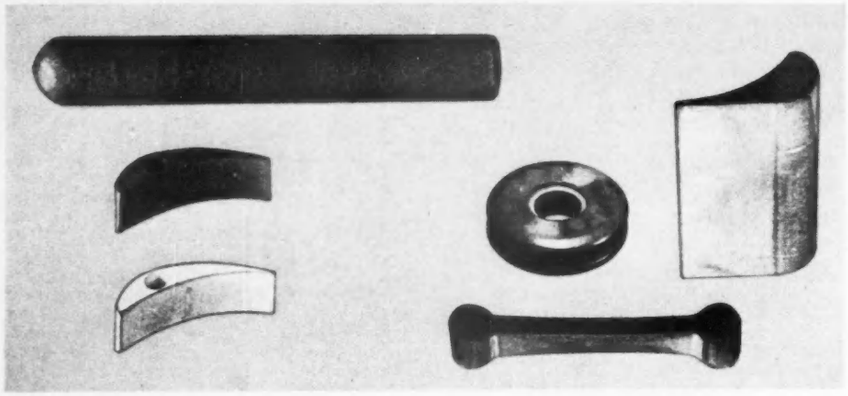
Norfolk County Council approved last week-end a scheme to buy from the British Transport Commission six lengths of now disused track for conversion into roads. Norfolk, as the House of Lords recently heard, has a chronic need for more roads both for industrial purposes and to serve holiday traffic to the coast and the Broads.

The county highways committee has reported that, on three of the lengths of former Midland and Great Northern track, the cost of conversion to roads would be greater than reconstructing what roads there already are. However, the roads made where the tracks had been will have a significantly better alignment. Thirty miles of track are involved and the total cost, with a Ministry of Transport grant of 75 per cent, is estimated to reach £1 million. The roads would be 24 ft wide and it would be possible to provide adequate verges.

Brigadier Lloyd, who was Deputy Engineer-in-Chief at the War Office at the time of his paper four years ago, visualised a 20,000 mile transport system which would have the immense advantage that the British railway system is, in his words, "virtually horizontal." The saving in journey time that this offers is rather higher than the saving worked out in the theoretical papers on M1 and an appreciable safety gain would presumably be made.

Silicon Ceramics for High Temperatures

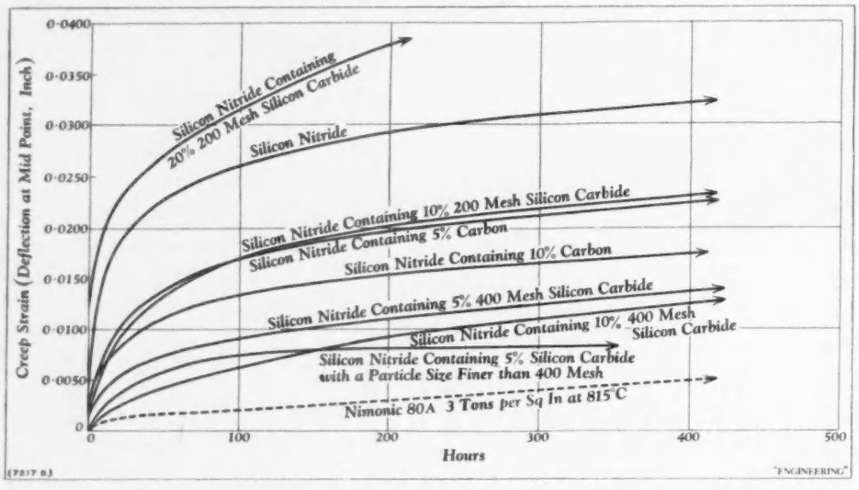
Recent improvements in ceramics based on compounds of silicon bring nearer the time when the high temperature resistance and strength of these materials can be made use of in engineering components.



Partially nitrided blade (middle left) is machined from compacted rod and nitrided to finished component. The three bodies shown on the right of the illustration were machined from presintered stock.

Two promising engineering ceramic materials are based on the metal silicon. The first of these is the carbide, and the second the nitride. They are members of a wide range of refractory families of compounds, others being the oxides, borides, silicides and aluminides. Although the high temperatures at which these materials melt or dissociate is generally very high, alumina, for instance, melting at 2,015° C and tantalum carbide at 3,880° C, the lack of thermal shock resistance to impact strength has slowed up their commercial exploitation. To overcome these shortcomings of ceramics, and silicon carbide and nitride are no exception, there have been two approaches to modification, firstly to the materials themselves by addition of metals to yield cermets, and secondly to the question of design which has yielded the rather well-worn comment that what is needed is a "new design philosophy." The latter is still true, although little exploited, and basically means designing with a material which has a different coefficient of expansion from metals, and arranging for it to be clear of stress raisers and used in compression.

Silicon carbide bodies were first made with a silicate bond and found wide use for refractory blocks in furnaces. Great improvement in chemical resistance and strength came when the silicon nitrided bonded version of this material was made, and even further improvement resulted from self bonding the material, in other words, silicon carbide bonded with silicon carbide. This last material is known as "densified" or KT silicon carbide and has properties shown in the table, compared with the older forms and with another similar material called GRB silicon carbide. This GRB is a more recent product of the Carborundum Company in America and is a dense body of silicon carbide which contains from 20 to 45 per cent graphite particles.



Creep of silicon ceramics under a bending load of 1·5 ton per sq. in at 1,200° C.

In these silicon based ceramics it can be seen that most bodies are composite, and contain varying amounts of the carbide, carbon (graphite), silicon and the nitride. This intermixing is desirable. The carbide bonded with the nitride is relatively inexpensive compared with the densified product, and the good corrosion resistance of the nitride is imparted to the mix. Tests reported in the Admiralty Materials Report No. A/75(S) by Parr, Martin and May illustrate that the creep strength of silicon nitride at 1,200° C is improved many times by addition of powdered carbon or silicon carbide. Results of this latter investigation are shown in the illustration. Although analysis of the properties of the GRB ceramic does not fully explain the reasons why, it is claimed by Carborundum that the presence of graphite granules in the body of this material improves the thermal shock resistance of the carbide by their ability to "absorb uneven expansions."

Silicon carbide oxidises to form a layer of silica, which, in the absence of reducing or low melting point glass-forming elements, is protective even above 1,000° C. The nitride oxidises very little, certainly at temperatures up to 1,200° C, but is attacked by potassium hydroxide at about 400° C and by sodium sulphate and vanadium pentoxide at 1,000° C. It happily resists molten non-ferrous metals and molten steel and iron for short periods of time.

In work at the Admiralty Materials Laboratory, the nitride has been made into turbine nozzle guide vanes and incorporated in a turbine working at 750° C. Clearances were such that the vanes were held in compression at working temperature. After 250 hours of intermittent service the silicon nitride was in a condition described as perfect.

Transverse Rupture Strength of Silicon Ceramics

—	Compacting pressure, tons per sq. in	Bulk density	Strength at 1,200° C, tons per sq. in	Strength at room temp. tons per sq. in
Silicon Nitride	16	2·5	13·0	9·8
	4	2·2	7·1	6·9
	2	2·1	6·8	5·3
	1	1·9	4·3	4·9
Nitride-10 per cent carbide	2	2·2	5·6	7·4
Nitride-5 per cent carbide	2	2·2	7·0	5·2
Nitride-5 per cent carbon	2	2·2	5·5	5·0

Source: AML Report No. A/75(S)

General Properties of Commercial Silicon Carbide Ceramics

—	Silicate bonded	Nitride bonded	Densified	GRB carbide
Density, gm per c.c.	2·6	2·9	3·1	2·8*a*
Mean thermal exp. 0-2,550° F, per ° F × 10^{-6}	2·4	2·4	2·2	2·7
Modulus of rupture, 77° F, lb per sq. in	2,200	5,500	24,000	8,700*b*
Thermal conductivity 2,200° F, Btu per hr per sq. ft per ° F per in.	109	113	293*c*	350*d*
Compressive strength, lb per sq. in	15,000	20,000	150,000	62,800
Modulus of elasticity 77° F, × 10^6 lb per sq. in	13·2	17	68	30*e*
Maximum Service Temperature, ° F				
Inert atmosphere	3,200	3,200	4,000	4,000
Oxidising atmosphere	2,900	3,000	3,000	2,800

a Low carbon *b* 1,830° F *c* 1,830° F *d* 1,600° F *e* 1,830° F

Source: Carborundum Company

Degreasing and Phosphating Together

In a new process announced by Du Pont, metal parts are given a phosphate coating while simultaneously being cleaned and degreased by immersion in a chemical bath based on trichlorethylene. In the bath are incorporated the phosphating chemicals and the whole is maintained at the boiling point of 188° F. As components leave the vapour zone they dry ready for immediate painting.

The coating, as formed on steel, is a strongly adherent form of iron phosphate which provides an excellent paint base. Coatings weigh from 40 to over 200 mg per sq. ft and can be achieved in from one half to three minutes immersion. Coatings can also be produced on other metals such as aluminium, magnesium and zinc. The machinery for this combined bath is fabricated by Blakeslee and Company, and the process will be commercially available in mid-1960.

E.I. Du Pont de Nemours and Company, Electrochemicals Dept., Wilmington, Del., USA.

G. S. Blakeslee and Company, Chicago, Ill., USA.

Fast Curing Stoving Enamel

Under a new licensing agreement with the Pittsburgh Plate Glass Company in the USA, a range of acrylic resins suitable for high temperature stoving enamels is being made by Styrene Co-Polymers Limited. These will be used by Lewis Berger to make exciting new enamels which will be sold under the name of Bergercron. The main outlet is for industrial and domestic " furniture " including containers, office furniture, refrigerators and cookers.

In the table, the properties of the enamel are compared with those of competitive coatings. Although not quantitatively expressed, the properties of Bergercron show no failings in contact with the chemicals likely to be encountered by the " furniture." What is more, the good properties are obtained by direct application to metals such as steel, aluminium and zinc alloys without primer.

Stoving is normally performed at 350° F for 30 minutes, which is comparable with that required for epoxy finishes and higher than the normal schedules for alkyd resin finishes. Recent work has shown that the temperature can be reduced to 300° F without sacrificing essential properties if modification is made. Going in the other direction, if stoving is carried out at 380° F, the curing time is halved, and raising the temperature above 400° F speeds the process up even further without damage to the coating. For a special application on steel razor blades, flame heating at 1,000 to 1,200° F effects curing in the short time of 4 to 5 sec to give a finish which will withstand immersion in boiling water for 2 minutes.

Performance of New Acrylic Stoving Enamel

	Bergercron	Alkyd amino over primer	Alkyd amino epoxy over primer	High temperature epoxy
Hardness ..	+++	–	+	++
Adhesion cross hatch ..	+++	++	+	+
Flexibility and impact ..	+++	+	+	–
Detergent resistance	+++	–	+	+++
Humidity resistance and water soak ..	+++	–	+	++
Colour stability on double stoving ..	+++	++	+	–
Hot fat resistance	+++	–	–	+++
Stain resistance	+++	+	+	+
Stoving temperature required	High 350° F	Medium 250° F	Medium 250-275°F	High 350-375°F

Key: +++ Outstanding. ++ Very good. + Normal for industry.

Lewis Berger (Great Britain) Limited, 173-9 Tyburn Road, Birmingham 24.

Standards Committee Sits on Rubber

The eighth meeting of the International Standards Organisation technical committee 45 took place in New York in October last. It marked the beginning of the sharing of responsibility for organising working parties on the many tests on rubber among different member countries. For instance, Italy will be the convening country for chemical tests, France for latex tests and standardisation of terms and definitions, and the USA for physical tests on unvulcanised rubber and static tests. The United Kingdom will convene for ageing and degradation, electrical and ebonite, and cellular rubber tests, the Netherlands for classification of vulcanised rubbers, and Germany for dynamic tests. Responsibility for product specifications will go either to the USA or Germany.

These further resolutions were made: to submit to the general secretariat a draft ISO recommendation for the determination of impact brittleness temperature; and for the secretariat to submit for postal approval amendments and additions for existing ISO recommendations for the determination of stress-strain and hardness. Larger tolerances are proposed on dimensions of the existing tensile test piece and an additional smaller test piece is suggested. In the hardness test the tolerances are tightened on ball sizes and leads, and a new small ball indentor with corresponding loads is proposed for use on samples of substandard thickness. This was originally called the micro-hardness test.

Coloured Pencils for Glossy Surfaces

This pencil is certainly not the first to write on glossy surfaces, but it does offer a point which will not turn brittle or go soft over the temperature range 30 to 100° F. This makes for economy in use compared with wax crayons.

The original black-lead version was introduced last year by the Plastic Packaging Division of Gordon and Gotch. Now this Swan " All-Stabilo " pencil is being marketed in six colours, red, white, blue, black, yellow and green. They can be used for writing on transparent wrappings, art and glossy paper, films, plastics, glass, metal, porcelain, stone, leather, foils and rubber.

Gordon and Gotch Limited, 75-79 Farringdon Street, London, EC4.

Aluminised Mild Steel Comes to Britain

In America and Canada the demand for hot-dip aluminised mild steel already runs into thousands of tons a year. In Britain the demand is still in three figures. Coated Metals are the people who make it. It is called Aludip, and comes at the moment in sheets from 10 to 20g, in sizes up to 4 ft by 3 ft.

Aluminising imparts good resistance to oxidation and to attack by sulphurous atmospheres. Such sheets can therefore be used for heat exchangers, silencers and exhaust systems, the car silencer being one of the largest markets for the material in America. Heat resistance is retained up to about 750° C, but if continually exposed to this temperature, the aluminium not only oxidises but also penetrates the steel sheet to give a reduction in ductility of the sheet.

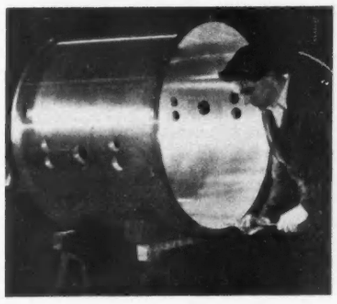
This brittleness is caused by the presence of an iron-aluminium intermetallic compound, and its control is important both during manufacture of the sheet and in subsequent operations such as welding. The aim is to keep the layer thin, or to avoid it altogether. Thus in dipping the steel sheet into molten aluminium at around 700° C, the time is so adjusted to obtain a 0·0015 in layer of aluminium and an intermetallic thickness of only 20 per cent of this. In the batch process—which involves pickling, fluxing, and hot dipping—the intermetallic layer can often rise to 50 per cent of the aluminium thickness.

Coated Metals are promoting use of the material in Britain if only because a larger demand would enable them to turn over to continuous production. Rather surprisingly, perhaps, it is quite easy to avoid brittleness in all welding processes except by arc methods. At the moment, 90 per cent of the British material is used in gas space heaters.

Coated Metals Limited, Palmerston House, Bishopsgate, London, EC2.

Tin-Aluminium Alloy for Solid Bearings

An aluminium alloy containing small amounts of tin has been used for bearings in place of conventional materials, such as Babbitt metals, both lead and tin based, and bronzes, for a number of years in Europe and the United States and it is being increasingly used in this country. Davy and United Engineering Company are now offering 6·5Sn-aluminium alloy bushes in their Morgoil specialised bearing system which has been fitted on the backup rolls of 7 ft and 12 ft steel rolling mills in this country. One mill has recently completed three years' service, during which time more than 500,000 tons of steel were rolled, and when the bearings were examined they were found to be in good condition. Bushes for bearings of this type are cast from Noral 730 aluminium alloy, this being particularly suitable as a bearing material where high loadings and speeds are encountered and where adequate lubrication is available. The illustration shows a bush 36 in in diameter and weighing 800 lb, fitted on a 7 ft mill. Other ferrous and non-ferrous metal rolling mills in this country and in Europe have been fitted with tin-aluminium bushes either as part of specialised bearing systems, such as Morgoil, or as plain bearings.



Bearing bush in 6·5Sn-aluminium alloy for a steel rolling mill.

Noral 730 is a 6·5Sn-2·5Si-1Cu-aluminium alloy. It has a 0·1 per cent proof stress of 4 tons per sq. in, an ultimate tensile stress of 10 tons per sq. in, and has been specifically developed for solid bearings, in other words bearings which do not need a backing material to give strength. With a thermal conductivity three times greater than that of steel and five times greater than Babbitt metal, Noral 730 is sufficiently plastic to conform to any normal misalignment, it embeds particles easily and is therefore highly suitable for heavy duty machinery such as rolling mills. These properties enable it, say Northern Aluminium, to be used at lower cost in place of brass for bushes in diesel engines, hydraulic presses and pumps, electric motors, cranes, dredgers, lathes and combine harvesters: applications that have been successful in the United States but the majority of which are untried in this country.

Northern Aluminium Company Limited, Banbury, Oxfordshire.

Plain Words

By Capricorn

When the Solartron Electronic Group came into the news last week because they were joining Firth Cleveland, I couldn't help feeling that the real significance of this move was being missed. All the talk of shares and profits and the rest of the financial paraphernalia overlooked the fact that here was a company engaged in some of the most advanced applications of electronics. Whatever the financial mechanics of the move, the important thing was that a group with a very successful technical record had more electronic tricks up its sleeve which it could only bring out if it had more capital.

Such a happy coordination of technical and financial opportunities raises a question of great importance: wherever there is technical opportunity and drive, do the necessary finance and backing follow?

There are two quite distinct areas in this matter: the private sector and the public sector of the economy; or as I would prefer to call them—the field of public action and the field of independent action. When there is a failure to grasp technical opportunity in the field of public action, we are all aware of it sooner or later, but we don't necessarily hear of all cases of failure in independent action. They must, I think, be comparatively few and slight.

For the really big projects, like atomic energy, public action is probably the only way, at least in the early stages. But it will only succeed if there is a clear path ahead and not too many opposing forces. For at least thirty years there were too many forces opposing the wider electrification of our railways, and there have been too many opposing the development of roads. In the eight years since the M1 motorway was first planned, electronic firms and other fast-developing firms have got on with their job and produced results. I have no doubt that there were forces opposing them too.

I once watched gangs of Egyptian labourers off-loading large wooden cases and crates of military stores from lighters on to the shore at Suez. No machinery was used; just bare hands. They would gather round a case of about 6 ft cube, an unnecessarily large number of them all jostling with each other and chanting a song. As there was no one in authority giving directions, each man pushed and shoved as he pleased. For a long time the case wouldn't budge because all the forces more or less cancelled out; then, by chance, a resultant was produced sufficient to start the case moving. The chanted song gave way to a primitive chorus of excited cheering as the case was propelled on to the shore—or, sometimes, into the Suez Canal.

I was reminded of that sight when we all joined in the jubilation over the opening of M1. Yes, the motorway had been built, but we had held the work up for nearly a decade. Like the Egyptian labourers, we should have been ashamed of our tactics, but no—the longer we delay any action the more we cheer at the end.

Letters to the Editor

Pass the Ammunition

SIR, Every weapon, with the exception of the spear, which nowadays we call the bayonet, becomes in its turn, obsolete.

Evidence exists to show that advanced thinkers hold that nuclear weapons will go the way of Greek fire, armoured ships and toxic smokes. The infantry can now beat the tank with its own personal weapons. Therefore, the ever-turning wheel of history places infantry once more back on its military pinnacle. The most severe problem now set to the infantry commander is the supply of ammunition to his forward elements, especially the heavier anti-tank types.

Here, the VTO aircraft comes in, but it need not be manned; in fact, it must not be. With the "known art" of wire guidance, a flying ammunition carrier may be steered from its dump to its dropping zone, even in the area of enemy small-arm fire, and back, by night or day, with no crew.

Such an enhancement of infantry fighting potential hardly needs stressing.

Your obedient servant,
L. V. S. BLACKER.

Cold Hayes, Liss, Hants.
29 December, 1959.

All Science in One Syllabus

SIR, As a junior student of mechanical engineering with an experimental bias, and as a relatively new reader of ENGINEERING, I was most interested in your article "Single Syllabus for Science" (ENGNG., 18 Dec. '59, p. 636).

Many teachers of technical subjects have expressed and stressed the view that the understanding of science as a single unit comprised of a number of inter-related and integrated subjects is of the utmost assistance and importance in the comprehension of any particular facet of it.

I would be much obliged if, on my behalf and on behalf of students generally, you would invite any readers to elaborate on this theme or to recommend specific publications which may further the general understanding of it.

I am, Sir, Yours faithfully,
A. ROBERTSON.

14 Eildon Terrace,
Newtown St. Boswells, Roxburghshire.
24 December, 1959.

Transatlation

SIR, This is a twofold request of which the first part concerns Capricorn whose comments we eagerly anticipate with each issue. In your 18 September issue Capricorn, in Plain Words, quoted Sir George Thomson in reference to the "populariser." Would you be so good as to explain the functions of the populariser for us? He is a mysterious individual who has not yet found a place in our dictionaries and we are anxious to understand him.

Part II of our request deals with terminology in the area of instrumentation and control or, if you will, automation. We feel, in this country, a definite lack of standard nomenclature in this field. Could you tell us if you have in Britain a nationally recognised standard control terminology? We shall be very grateful for a paragraph or two on this subject. If at all possible we would like to have a copy of any such standard or, in lieu of it, the source where such might be obtained.

Very truly yours,
A. W. HINDENLANG,
Associate Editor.

Combustion,
200 Madison Avenue, New York 16.

Editor's Note: The popularizer does in fact appear in the *Shorter Oxford English Dictionary*, but for the benefit of our "Webster-bound" transatlantic readers, we would add that the ranks of popularisers—we prefer the s to the z—include such people as Lancelot Hogben in mathematics, and Ritchie Calder in science generally, both successful interpreters of science and technology to the layman.

The basis of standard British terminology in this field is the British Standard 1523 *Glossary of Terms used in Automatic Controlling and Regulating Systems*, of which three parts have been published, viz., Section 2, Process Control (at present under revision), Section 3, Kinetic Control, and Section 5, Components of Servo-Mechanisms. (All available from the British Standards Institution, 2 Park Street, London, W1.)

Remote Reactors

SIR, I refer to your Leader entitled "Time to Pick a Winner" (ENGNG., 23 Oct.'59, p. 365).

In the course of your remarks, you suggest "Build a prototype abroad, preferably in the Commonwealth and within reach of a materials-testing reactor and other research facilities, and under special guarantee and conditions of sale."

This does, perhaps, raise the question as to whether it would be possible to build a small prototype reactor in Australia at a site sufficiently isolated to take full advantage of the reactor's independence of bulky fuel supplies but near enough to the Lucas Heights establishment for access to development resources.

The answer is "no." Lucas Heights is located in New South Wales about 25 miles south of Sydney. The New South Wales electricity supply system is fairly well developed, extending to the Victorian border in the south, the Queensland border in the north and to most inland towns within 300 miles of the coast. The only isolated town with a significant power demand and not yet connected to the New South Wales grid is Broken Hill which is over 700 miles from Sydney and hence too far from the Research Establishment to consider for an experimental prototype.

Yours faithfully,
D. R. GRIFFITHS,
Power Study Engineer.

Australian Atomic Energy Commission,
Box 5343, GPO,
Sydney, NSW.
22 December, 1959.

Events in Advance

From Toys to Fancy Goods

It is appropriate to the present season that three exhibitions devoted to toys and gifts should be due to take place in different parts of England during the next few weeks. The earliest, the International Toy Fair at Harrogate, opens in that town tomorrow and will continue until today week. This year's fair is the eleventh of the series and a wide range of toys will be on exhibition, including many new designs of electrical, engineering and railway interest.

The next to be held is the five-day International Gifts and Fancy Goods Fair, which will open at Blackpool on 1 February. It is the eleventh of the series of such fairs to be organised by the Fancy Goods Association, London, and is expected to be on an appreciably larger scale than those held previously.

Lastly, there is the Seventh British Toy Fair, at Brighton, which will run from 15 to 19 February. The organisers, the British Toy Manufacturers Association, estimate that more than 200 makers of toys will exhibit, occupying a total of some 55,000 sq. ft of space. Accommodation has been taken by the Association at the Bedford, Grand and Metropole Hotels and, in addition, several firms will be showing their products at the town's Corn Market. An idea which is being developed by the Association is the provision of free taxi services between the various exhibition centres for the convenience of home and overseas buyers. A number of continental firms will take part in the fair for the first time and, in consequence, products

will be on show from Austria, Denmark, France, Italy and Western Germany.

Another item of continental interest in relation to toys is the six-day International Toy Fair at Nuremberg which opens on 3 March and for which Mr. Neven du Mont, 123 Pall Mall, London, SW1, is the agent.

Exhibitions and Conferences

Toy Fair, 11th International.—Sat., 9 Jan., to Fri., 15 Jan., at Harrogate. Organised by Harrogate International Toy Fair Ltd., Finsbury Court, Finsbury Pavement, London, EC2. Tel. MONarch 8921.

Health Physics and Nuclear Power Lecture.—Wed., 13 Jan., at 45 Great Peter Street, London, SW1. By B. C. Godbold. Arranged by the Women's Engineering Society, 25 Foubert's Place, London, W1. Tel. GERrard 5212.

Scientific Exploration of Space, Schools Lecture.—Sat., 16 Jan. (3 p.m.), at Church House, Great Smith Street, London, SW1. By Dr. N. H. Langton. Apply to the British Interplanetary Society, 12 Bessborough Gardens, London, SW1. Tel. TATe 9371.

Gifts and Fancy Goods Fair, 11th International.—Mon., 1 Feb., to Fri., 5 Feb., at Blackpool. Organised by the Fancy Goods Association, St. Dunstan's House, Carey Lane, London, EC2. Tel. MONarch 0871.

Amusement Trades Exhibition, 16th.—Tues., 2 Feb., to Thurs., 4 Feb., at the Royal Horticultural Society's New Hall, Greycoat Street, London, SW1. Organised by Amusement Trades Exhibition Ltd., 19 Charing Cross Road, London, WC2. Tel. WHItehall 2524.

Liquid Gases, Industrial Lecture and Demonstration for Science Sixth Formers.—Fri., 12 Feb. (4.30 p.m.), at the Science Museum. By Dr. F. Din. Apply to the Director, Science Museum, Exhibition Road, South Kensington, London, SW7. Tel. KENsington 6371.

British Toy Fair.—Mon., 15 Feb., to Fri., 19 Feb., at Brighton. Organised by the British Toy Manufacturers' Association, 93-94 Hatton Garden, London, EC1. Tel. CHAncery 9158.

Toy Fair, Nuremberg International.—Thurs., 3 Mar., to Tues., 8 Mar., in Nuremberg. Agent: Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Motor Show, Geneva International.—Thurs., 10 Mar., to Sun., 20 Mar., in Geneva. Organised by the Fondation du Salon de l'Automobile, 1 Place du Lac, Geneva, Switzerland.

Stationery and Allied Trades Fair, Sixth National.—Mon., 28 Mar., to Fri., 1 April, at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Organised by the *National Newsagent, Bookseller, Stationer*, 149 Fleet Street, London, EC4. Tel. CITy 2604.

Fuel Efficiency and Power for Industry Exhibition.—Wed., 27 April, to Fri., 6 May, at Olympia, London, W14. Organised by Provincial Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

Paris Trade Fair, 50th International.—Sat., 14 May, to Sun., 29 May, in Paris. Apply to the French Chamber of Commerce, 74 Brook Street, London, W1. Tel. HYDe Park 2744.

Swiss Import Exhibition (ZUSPA) (Technical Goods).—Fri., 20 May, to Sun., 29 May, at Zürich, Exhibition offices: 20 Nordstrasse, Zürich 6.

Budapest Industrial Fair.—Fri., 20 May, to Mon., 30 May, in Budapest. Apply to the Hungarian Chamber of Commerce, 17 Rosenberg h.p.u., Budapest V, Hungary.

Institution of Mechanical Engineers Summer Meeting.—Mon., 20 June, to Thurs., 23 June, in Northern Ireland. Organised by the Institution of Mechanical Engineers, 1 Birdcage Walk, London, SW1.

Malta Trade Fair, Fourth.—Thurs., 30 June, to Sun., 10 July, at Valletta. Organised by the Malta Trade Fair Corporation, Exchange Buildings, Valletta.

Royal Agricultural Society Show.—Tues., 5 July, to Fri., 8 July, at Cambridge. Organised by the Royal Agricultural Society of England, 35 Belgrave Square, London, SW1. Tel. BELgravia 5323.

Commercial Motor Transport Exhibition, International.—Fri., 23 Sept., to Sat., 1 Oct., at Earl's Court, London, SW5. Organised by the Society of Motor Manufacturers and Traders Ltd., Forbes House, Halkin Street, London, SW1. Tel. BELgravia 6611.

Royal Horticultural Society's Great Autumn Show.—Tues., 27 Sept., to Thurs., 29 Sept., at the Royal Horticultural Society's Old and New Halls, Vincent Square and Greycoat Street, London, SW1. Offices of the Society: Vincent Square, London, SW1. Tel. VICtoria 4333.

Cycle and Motor Cycle Show, 33rd.—Sat., 12 Nov., to Sat., 19 Nov., at Earl's Court, London, SW5. Organised by British Cycle and Motor Cycle Industries Ltd., Eaton Road, Coventry. Tel. COVentry 62511.

Commonwealth Mining and Metallurgical Congress, Seventh.—During April and May, 1961, in South Africa. Apply to the Congress Manager, PO Box 809, Johannesburg.

Meetings and Papers

British Institution of Radio Engineers

LONDON
"A Proposed Space-Charge-Limited Dielectric Triode," by Dr. G. T. Wright. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 13 Jan., 6.30 p.m.* (Change of arrangements.)

Chemical Engineering Group

LONDON
"Critical Examination and Joint Technological Approach to Project Work in the Chemical Industry," by H. Birchall and D. S. Binsted. Tues., 12 Jan., 6 p.m.

Chemical Society

LONDON
"Progress in the Study of Heterogeneous Catalysis," by Professor C. Kemball. Tilden Lecture. Royal Institution, Albemarle Street, W1. Thurs., 14 Jan., 7.30 p.m.

Combustion Engineering Association

LONDON
"Factors Affecting the Choice of New Boiler Plant." Discussion opened by W. Short. Southern Region. St. Ermin's Hotel, Caxton Street, SW1. Thurs., 14 Jan., 10.30 a.m.

Illuminating Engineering Society

EDINBURGH
"Hospital Lighting," by G. R. N. Chalmers. Edinburgh Centre. YMCA, 14 South St. Andrew Street, Edinburgh. Wed., 13 Jan., 6.15 p.m.

Institute of Fuel

NEWCASTLE UPON TYNE
"Fuel, Oxygen and Electricity in Steel Making," by Professor M. W. Thring. North Eastern Section. King's College, Newcastle upon Tyne. Tues., 12 Jan., 5.30 p.m.*

Institute of Marine Engineers

MANCHESTER
"Human Problems in Marine Engineering," by C. C. Pounder. Merseyside and North Western Section. Engineers' Club, Albert Square, Manchester 2. Mon., 11 Jan., 6.45 p.m.

Institute of Metal Finishing

LONDON
"Stoving Paint Systems," by A. W. Greig and F. G. Randall. Organic Finishing Group. British Institute of Management, 80 Fetter Lane, EC4. Wed., 13 Jan., 6.30 p.m.

Institute of Physics

LONDON
"Problem of Primary Cosmic Radiation," by Professor J. G. Wilson. London and Home Counties Branch. Mon., 11 Jan., 6 p.m.

Institute of Road Transport Engineers

GLASGOW
"Taking Stock on Maintenance," by P. H. Wyke-Smith. Scottish Centre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Mon., 11 Jan., 7.30 p.m.

Institute of Welding

LONDON
"High-Temperature Brazing—A Modern Joining Method," by E. R. Perry. South London Branch. Wed., 13 Jan., 7 p.m.

Institution of British Agricultural Engineers

LONDON
"New Methods in Silage Handling," by F. S. Mitchell and N. W. Dilke. Tues., 12 Jan., 2.15 p.m.

Institution of Civil Engineers

LONDON
"Some Experiments in Artificial Recharge in the Lower Lee Valley," by E. S. Boniface. Tues., 12 Jan., 5.30 p.m.*

Institution of Electrical Engineers

LONDON
"A Quadrature Network for Generating Vestigial-Sideband Signals," by G. G. Gouriet and G. F. Newell; "Input Impedance of Rectifier Modulators," by Professor D. G. Tucker; and "Rectifier Modulators with Frequency-Selective Terminations," by D. P. Howson and Professor D. G. Tucker. Electronics and Communications Section. Mon., 11 Jan., 5.30 p.m.*
"Gaseous Discharge Phenomena in High-Voltage Direct-Current Cable Dielectrics," by E. C. Rogers and D. J. Skipper. Supply Section. Wed., 13 Jan., 5.30 p.m.*

BRISTOL
"Application of Low-Pressure Resins to Some High-Voltage Switchgear Designs," by T. R. Manley, K. Rothwell and W. Gray. Western Centre. The University, Bristol. Mon., 11 Jan., 6 p.m.*

Institution of Engineering Designers

NEWCASTLE UPON TYNE
"Use of Radioactive Isotopes in Industry," by T. V. Suttar. North East Branch. Rutherford College of Technology, Northumberland Road, Newcastle upon Tyne 1. Mon., 11 Jan., 7.15 p.m.

Institution of Engineers-in-Charge

LONDON
"Water Treatment and Its Control," by C. J. Hasler. Caxton Hall, off Victoria Street, SW1. Wed., 13 Jan., 6.30 p.m.*

Institution of Heating and Ventilating Engineers

LIVERPOOL
"Warm Air Door Curtains," by J. N. Saunders. Liverpool Branch. Exchange Hotel, Tithebarn Street, Liverpool. Wed., 13 Jan., 6 p.m.

Institution of Mechanical Engineers

LONDON
"Recognition of Deterioration of Lubricants in Service." Lubrication Group Discussion. Mon., 11 Jan., 6 p.m.*
"Combustion Chamber Design and the Influence of Fuel Quality," by D. Downs. Crompton-Lanchester Lecture. Automobile Division. Tues., 12 Jan., 6 p.m.*
"Strength of Rails, with Particular Reference to Rail Joints," by S. Wise, D. Lindsay and I. G. T. Duncan. Wed., 13 Jan., 6 p.m.*

Institution of Plant Engineers

GLASGOW
"Selection of Heating Systems for Factories and Offices," by T. Turner. Glasgow Branch. Scottish Building Centre, 425-427 Sauchiehall Street, Glasgow. Thurs., 14 Jan., 7.15 p.m.

Institution of Production Engineers

LEEDS
"Production Engineering Problems in Connection with the Manufacture of Tubes," by D. B. Such. Leeds Section. Hotel Metropole, King Street, Leeds 1. Mon., 11 Jan., 7 p.m.

Institution of Public Health Engineers

LONDON
"Coal Preparation Effluents and Their Treatment," by W. G. Harper. Caxton Hall, off Victoria Street, SW1. Thurs., 14 Jan., 6 p.m.

Institution of the Rubber Industry

LONDON
"Chemical Plant Lining," by J. Westhead, at 5.30 p.m.
"Hypalon Coatings," by Dr. J. N. Milne, at 7 p.m. 26 Portland Place, W.1. Tues., 12 Jan.

Junior Institution of Engineers

LONDON
"A Radio Navigation Aid for Ships and Aircraft," by C. Powell. Fri., 15 Jan., 7 p.m.*

Manchester Association of Engineers

MANCHESTER
"Aircraft Blind Landing Systems," by J. S. Shayler. Engineers' Club, Albert Square, Manchester. Fri., 15 Jan., 6.45 p.m.

Manchester Statistical Society

MANCHESTER
"Forecasting in the Synthetic Fibres Industry," by Howard Morris. Manchester Reform Club, King Street, Manchester. Wed., 13 Jan., 5.30 p.m.

Royal Aeronautical Society

LONDON
"Biological Factors in Agricultural Aviation," by C. V. Dadd. Agricultural Aviation Group. Fri., 15 Jan., 7 p.m.

Royal Society of Arts

LONDON
"Training of Staff for Foreign Posts: A Dutch Experiment," by Dr. E. B. J. Postma. Wed., 13 Jan., 2.30 p.m.

Royal Statistical Society

BRISTOL
"Role of Statistics in Operational Research," by Dr. K. D. Tocher. Bristol Group. The University, Bristol 8. Thurs., 14 Jan., 5.45 p.m.*

West of Scotland Iron and Steel Institute

GLASGOW
"Engineering Aspects of a Modern Open-Hearth Steel Plant," by J. A. Kilby and J. C. Gordon. Fri., 15 Jan., 6.45 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Engineering Group, 14 Belgrave Square, London, SW1. (BELgravia 3647)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
Combustion Engineering Association, 70 Jermyn Street, St. James's, London, SW1. (WHItehall 5536)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1. (LANgham 7124)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Metal Finishing. Apply to 11A Gloucester Road, London, SW7. (KNIghtsbridge 9181)
Institute of Physics, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institute of Welding, 54 Princes Gate, Exhibition Road, London, SW7. (KNIghtsbridge 8556)
Institution of British Agricultural Engineers, 6 Queen Square, London, WC1. (TERminus 0140)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Engineers-in-Charge, 13 Grange Close, Edgware, Middlesex. (MILl Hill 3543)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Bridcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of Public Health Engineers, 179-181 Vauxhall Bridge Road, London, SW1. (VICtoria 3017)
Institution of the Rubber Industry, 4 Kensington Palace Gardens, London, W8. (BAYswater 9101)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Manchester Association of Engineers, 18 Booth Street, Manchester 2. (Central 1717)
Manchester Statistical Society: Industrial Group. Apply to Mr. T. J. Lunt, Ferranti Ltd., Hollinwood, Lancs.
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Royal Statistical Society, 21 Bentinck Street, London, W1. (WELbeck 7638)
West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)

Continental Road Practice

Inter-country roads are essential to the tourist, commercial and industrial growth of Southern Europe. Work in Austria, Italy and Switzerland is relevant to other areas with a medium density of population.

For southern European countries, the way to economic progress lies straight down their own highways. Better roads, especially international routes, are a major need, particularly if tourists are to be attracted to the area.

To assist the development of such a road system, the United Nations Technical Assistance Administration financed a study of road work in Austria and Italy. These two countries were chosen because of their advanced construction techniques over a variety of terrain—flat to mountainous, rock to clay sub-grades, river bed to seashore. Some of the findings are presented below, together with some observations on Swiss road engineering that are taken from a lecture sponsored by the Cement and Concrete Association late last year in London and given by Herr W. Schüepp, of Betonstrassen A.G., Wildegg.

The United Nations study group found that road expenditure in Austria brings immediate and remarkable returns in tourist travel by road. The arrangement of the Austrian main road system is three-fold: (1) motorways with two separate and independent one-way carriageways; (2) express roads for fast moving traffic, and (3) through roads. To maintain these, 3,000 men are in constant employment supervised by some 300 engineers. The administration is financed by a fuel tax and, in addition, the motorways by a special budget grant.

The motorways have an overall width of 28·5 metres, a non-skid bituminous surfacing with cobblestones on either side of the carriageway, and curves designed for speeds of 140 km and 120 km per hour. Horizontal and vertical curves are combined to allow for the greatest visibility and travelling comfort.

One of the most important motorways in the country, running between Vienna and Salzburg, is designed for a maximum speed of 140 km per hour. As the country between Vienna and Salzburg is hilly, this motorway crosses a large number of valleys and requires as many as 620 bridges in a distance of 310 km. Of these, 220 have been completed, 80 are under construction and 210 are at the planning stage; 110 were finished during the war. The cost of this motorway is put at only 800,000 schillings per km (£17,500 per mile).

LANDSCAPING

The largest bridge on the Vienna-Salzburg section is the Aitertal with a total length of 507 metres. It is of prestressed concrete, which was chosen for both economic as well as for aesthetic reasons. The piers were finally covered with stone slabs to fit the bridge into the landscape. This attention to landscaping prevails throughout Austria, and embankments are often covered with slabs of stone of the region and even the colour of road surfacing is chosen purely according to the character of the countryside. The use of advertising boards is prohibited on federal roads.

The density of traffic over any given stretch is another factor for constant consideration. The Trieste Federal Highway has an average traffic of 5,000 vehicles a day with 1,500 at peak periods. To keep this volume of traffic on the move, carriageways are having to be widened, gradients reduced, urban centres bypassed and cycle and pedestrian paths built apart from the main roads. Road guards are now of sprung steel, supplanting the concrete types which are considered too rigid.

Perhaps the greatest difficulty facing the road engineer is frost, snow and flood. On the Semmering Pass, where the road is planned for a maximum speed of 60 km per hour with 35 km per hour at bends, the surfacing is composed of two layers of concrete separated by steel wire netting, the upper layer containing quartz sand and porphyrite gravel. Steel dowels tie each section of concrete together. The road is protected from landslides by a 10 metre high concrete embankment with a base width of 4 m and 2 m at the top. Above the embankment, trees have been planted which will be tied later to hold back snow drifts.

In Italy, to some 25,000 km of trunk roads, 45,000 km of provincial roads, 107,000 km of municipal roads, have recently been added a great length of toll motorways. The most impressive of these is the motorway linking Milan, Rome and Naples—the *Via del Sole*. Its total length is 738 km and it is designed for a speed of 160 km on the level and 120 km elsewhere.

The uniform width of this highway is 24 m and its two carriageways of 7·5 m each are separated by a 3 m central strip; hard shoulders of 3 m make up the full width. Visibility is at least 180 m.

There are no intersections on the *Via del Sole*, only underpasses and flyovers. Bridges over the road are generally of a standard type, comprising two independent spans with a central pier. In dangerous zones, the central pier has been eliminated and the crossing is made by a single span of 26·5 m.

Where the motorway has to cross rivers, or the flood plains of the Po or in the Appenine regions, most imposing structures are being built. In the Milan-Bologna section alone, 15 large bridges have either been built or are in process of being completed. For several bridges, prefabricated piers were used. The largest bridge over the Po has a total length of 1,176 m and 16 spans.

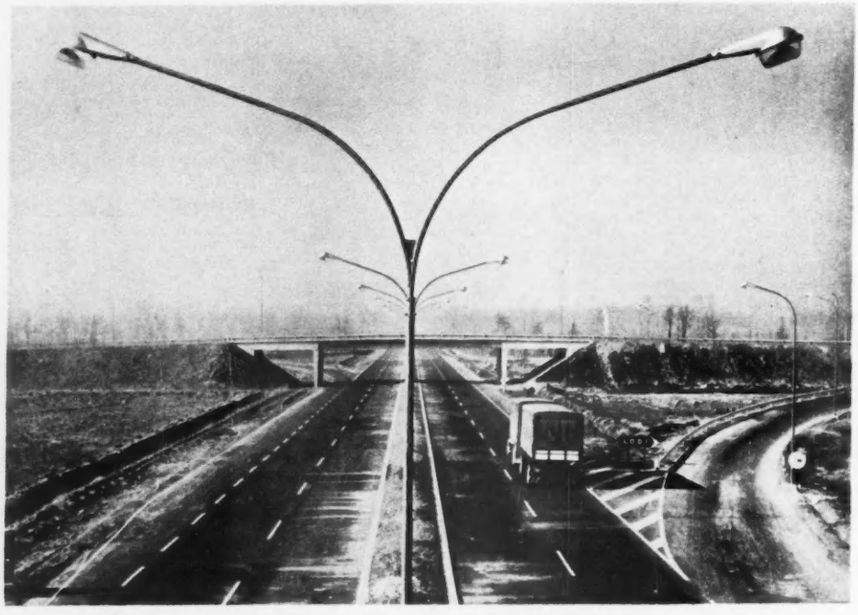
The only stretch which includes tunnels is that between Florence and Bologna, where 49 tunnels having a total length of 11,049 m are being driven. To avoid the danger of dazzling, the bores have been duplicated, each carriageway using a separate tunnel.

Road research in Italy has been carried on into the problems of traffic signs, route markings, safety installations and provisions for assistance. There are now no kilometre stones, only markers in thin sheet metal or plastic which offer little resistance if hit. All structures are protected by parapets. Retaining walls and entrances to tunnels have guard rails.

The traditional road maintenance system has been superseded by radio-equipped motorised units. The surfaces of the motorway are "absolutely" waterproof, which allows the use of chemical de-icing substances.

The *Via del Sole* has its own police force, one station for every section of 35 km. Begun in 1956, the motorway will be completed by 1961. Its cost (except where the terrain is very broken) is 250 million liras per km (£200,000 per mile). The toll system is planned on American lines.

In Switzerland, Herr Schüepp explained, the soil has little uniformity from the point of view of good road foundations. It is rarely very bad, except in the regions where there is peat, and it is rarely very good, except where certain gravel deposits are crossed. Under old concrete roads there is a bed of rolled sand and gravel some 6 in to 10 in thick, and experience has shown that, even on soils repeatedly frozen, this foundation is sufficient to avoid damage to the carriageway, so long as adequate drainage precautions are taken. This bed of gravel is topped by a thin layer of sand (0-$\frac{1}{8}$ in) some 0 to 1 in thick, designed to improve the level and to lessen the resistance to movements of the slabs. There have been instances where the subgrade has mixed with the gravel base, and damage has occurred.



A completed section of the Via del Sole, which will finally link Milan, Rome and Naples.

DURABLE SURFACES

For most roads the carriageway slabs have a thickness from 6$\frac{3}{8}$ in to 7 in according to local conditions; for the new motorways, the slab is generally heavier, from 7$\frac{1}{16}$ in to 8$\frac{1}{8}$ in. Road pavements are all laid in two layers for the following reasons. Indigenous deposits of sand and gravel of glacial river origin are rarely satisfactory for the running surface of roads. These materials are therefore used for the lower layer of the slab, mixed with Portland cement in the proportions 1 : 2·5 : 4. However, for the upper layer of 2 to 8$\frac{1}{8}$ in, the aggregate is chosen for its wearing quality and has often to be imported over long distances. The concrete mix of the upper layer is 1 : 3 : 5, and it is placed imme-

diately after the lower layer. Separation of the two layers has never been experienced. The compaction is generally done in one pass.

Slabs are constructed with a light reinforcement of steel mesh, placed between the two layers and the edges are additionally reinforced by bars placed in the lower layer; in all, 0·37 to 0·51 lb per sq. ft of reinforcement is used.

FINISHING MACHINES

Construction joints are at every 9 to 13 yards, most often at 11 yard intervals. Every 55 to 110 yards there are expansion joints, formed by placing a strip of flat or corrugated asbestos erect on the ground before concreting.

For the last 20 years all transverse joints have been dowelled with $\frac{3}{4}$ in diameter steel bars. In the longitudinal joints there are bars of $\frac{5}{16}$ to $\frac{1}{2}$ in diameter.

Many of the older routes were constructed with the aid of lightweight finishing machines, which also had to be used for mountain roads where often the site for casting the concrete was squeezed between a wall or rock-face and the other half of the road had to remain open for the traffic. Every fraction of inch was precious and very narrow machines were essential, but they also had the advantage of being very manageable. Moreover, with these lightweight finishers it was only necessary to have light forms which eased transport to the remote sites.

These finishers also had a peculiarity rarely found elsewhere: as well as a vibrating beam they had a reciprocating beam which completed the compaction of the concrete and left on the surface a series of ridges or corrugations which were thought desirable on steep gradients.

Among the improvements that have been brought about by the gradual increase of loads and speeds, mention must be made of the thicker and better substructure, an increase of the concrete slab thickness for motorways to 8 to 9 in, the strengthening of the dowels, and construction of the joints with corrugated asbestos. Paper or a plastic film is frequently imposed between the foundation and the road slab.

The new motorways normally have a width of 26 ft 3 in providing two traffic lanes. On the side of each lane there is a marking strip 2 ft wide in white cement about 1 in thick.

RIDING QUALITY

One of the main problems has been the construction of a smooth surface giving an above average riding quality where the joints cease to be noticeable. This has necessitated the use of heavier machinery and more stable and rigid formwork. Site mechanisation is also being improved by the use of transverse joints (using carborundum or diamond discs, vibrating blades to cut the wet concrete) and, at last, the use of the longitudinal finisher.

To obtain a high riding quality and also a secure grip, the smooth surface of the concrete is treated with a fine brush or now with the longitudinal finisher. This gives a roughness like coarse sandpaper. For this characteristic to endure, a sand with high percentage of hard grains is used in the surface though this is expensive in Switzerland.

As far as expansion joints are concerned, they are being placed with advantage close to bridges and curves, but on straight sections only every 110 yd or more. Contraction joints are every 11 yd. On deep fill or above expected settlements, the distance between these joints is reduced to 5 to 6 yd.

Newly laid concrete is covered after 4 to 6 hours with moist sand to improve curing conditions; the use of curing films is allowed, but moist sand is preferred.

For the future, Herr Schüepp mentioned that some experimental lengths of prestressed concrete road had been laid in Switzerland. The earliest examples had slabs only $4\frac{1}{2}$ in thick and with "active" joints—where the prestress was applied—at intervals of 225 ft. In a more recent example, however, the slab thickness was increased to 6 in and the active joints spaced out at nearly 400 ft intervals.

Current from Kariba

The first electricity was generated at Kariba in the last few days of 1959. This was in accordance with the schedule issued as work on the dam was commenced. Work on the wall itself was completed at the end of November last year. Installation of electrical equipment in the turbine house began last February. The project is to be officially opened by the Queen Mother next May or early June.

The estimated cost of the project is £38 million for the civil engineering and £19,600,000 for the electrical equipment. Consulting engineers for the scheme have been Sir Alexander Gibb and Partners in association with MM. A. Coyne and J. Bellier, S.O.G.E.I., and Merz and McLellan.

The ultimate installed generating capacity of Kariba will be at least 1,500 MW, with an estimated annual output of at least 9 million MWhr; initially only six 100 MW turbo-generators are being installed. Most of the electrical equipment is being made in Britain, much of it by the AEI group: the generators by the Heavy Plant division at Manchester (formerly Metropolitan-Vickers), the switchgear by the Willesden division (BTH) and certain of the cables by another AEI member, Siemens Edison Swan. Bovings Limited are making the Francis turbines.

As already noted, the first generator is now on load; the second is due to come into service on 1 May next. It was originally intended that the six generators should be commissioned at the rate of two a year, but this schedule has been speeded up so that three machines will come into operation in 1960, two in 1961 and the sixth in 1962.

Overseas Work by British Consultants

The Association of Consulting Engineers has issued its annual brochure listing the work being undertaken by British consulting engineers in the 60 or 70 countries in which they are engaged overseas. All forms of engineering are covered, from airports to roads and railways, and from thermal power stations to sea outfall sewers.

Work being done by members of the association on the construction of new harbours, extensions to existing docks, port reclamation, provision of new berths, and associated equipment including dredgers, amounted during last year to no less than £70 million. Even greater was the volume of work in respect of hydroelectric projects: here the value of work under construction was £125 million.

A second section of the brochure is devoted to schemes that are still in the preliminary stages of investigation and report. These projects include the Volta River works for producing aluminium, the nuclear power station for the Societa Ellettro-Nucleare Nazionale of Italy, the Northumberland Straits road/rail sea crossing and the Peace River development in Canada, and many more besides.

Copies of the brochure can be obtained from the association whose address, as from 1 January, is Abbey House, 2 Victoria Street, London, SW1.

Structural Design of Nuclear Reactors

Structural problems met in the design of nuclear power reactors will be the subject of a residential course held in the engineering department of Southampton University from 4 to 8 April, 1960.

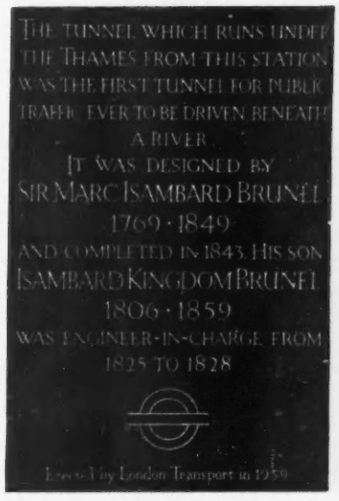
A broad outline will be given of modern methods of analysing statically indeterminate structures, followed by an examination of the state of stress in structural components of a reactor subjected to loading and thermal effects. Both the elastic and plastic states will be considered, and observations will be made on the application of electronic digital computers to the analyses. The effect of radiation on engineering materials and constructional techniques, in so far as they affect design, will also be considered.

Including accommodation and meals, the fee for the course will be £20. Inquiries should be addressed to the organising secretary, Dr. J. R. Rydzewski, at Southampton University.

Brunel Plaque in London

London Transport have prepared for erection at Wapping Station, on their East London line, a plaque recalling the connection with the Thames Tunnel of Isambard Kingdom Brunel (1806-1859) and his father, Sir Marc Isambard Brunel (1769-1849). It is especially fitting that the plaque should have been ready at the end of 1959, for that year was the centenary of the death of I.K. Brunel, best known for his work as engineer of the Great Western Railway.

Access to the platform is through one of the circular shafts of the original Thames Tunnel,


THE TUNNEL WHICH RUNS UNDER
THE THAMES FROM THIS STATION
WAS THE FIRST TUNNEL FOR PUBLIC
TRAFFIC EVER TO BE DRIVEN BENEATH
A RIVER
IT WAS DESIGNED BY
SIR MARC ISAMBARD BRUNEL
1769 · 1849
AND COMPLETED IN 1843 HIS SON
ISAMBARD KINGDOM BRUNEL
1806 · 1859
WAS ENGINEER-IN-CHARGE FROM
1825 TO 1828
Erected by London Transport in 1959

London Transport's plaque commemorating the Brunels, father and son.

built between 1825 and 1843 by Sir Marc; his son was engineer-in-charge of the work from 1825 to 1828.

The above-ground part of Wapping Station is now being reconstructed and the plaque will be moved from its present temporary position to its final prominent position at the end of 1960 as the work is completed. The plaque is 30 in high by 20 in wide.

Payment for Exposed Work

As from 4 January the Civil Engineering Construction Conciliation Board has agreed that amended rates of additional allowances should be made to operatives on "exposed work." The additions now range from 1*d* per hour at 125 ft up to 3*d* per hour above 200 ft. "Exposed work" is work on any structure where there is no temporary or permanent protection from the weather. The heights are measured above ground level.

Quite irrespective of this exposed work payment, it is becoming more and more the practice to erect protection against the weather. This is not only in the interest of the men's well-being, but it also leads to conditions where better work is done and where interruptions to work are less frequent, all with corresponding savings in total costs.

Such use of shelters is not confined solely to work at height, but is also being found advantageous at low levels; indeed the time may well come when most public works are carried out under cover, including road works, with much improved results all round.

Racing Designs Bred by Formula Junior

"Formula Junior" is a new racing formula for 1,000 and 1,100 c.c. cars. It is designed to keep down construction costs and should encourage racing.

By Gordon Wilkins

1960 is the last year of the current Grand Prix formula for unsupercharged 2½-litre cars and does not seem likely to produce any very interesting developments in this sphere unless Mr. Vandervell decides to resume racing with his redesigned cars, which he was prevented from doing by illness last year. Ferrari has already announced that he does not intend to produce new designs for 1960. Sports car racing under the 3-litre limit is also moribund and seems likely to be replaced by events for Gran Turismo models.

The most interesting developments are therefore to be expected in cars built for the new Formula Junior which made a highly successful entry to the international scene last year. These little single seaters, built from touring car components, have already put up some magnificent performances. One of them beat all comers to make best time of the day at the international Gaisberg hill climb, and another, a Stanguellini with a Fiat 1,100 c.c. engine, in which a young Swiss driver won the first Junior event at Monaco, easily beat the lap record established by Fagioli in a 500 b.h.p. supercharged Mercedes on the same circuit in 1935.

The formula originated in Italy and seems likely to replace Formula 3, which has produced many outstanding drivers, including Stirling Moss and Peter Collins, but has been stultified by the unassailable supremacy of one engine, the Norton single-cylinder. Formula Junior cars must use engine and other major components from a touring car at least 1,000 of which have been sold in one year. The regulations are framed to keep down the cost of construction and so encourage new drivers to start racing, but they have not prevented a wide variety of cars appearing. Engines with twin overhead camshafts are barred. To bring in as many engines as possible, two classes have been established, 1,000 c.c. and 1,100 c.c. with differences in the minimum car weight, to permit them to race together on equal terms. 1,000 c.c. cars must weigh at least 360 kg and 1,100 c.c. cars 400 kg. Cylinder bores may be increased or reduced to bring an engine within these limits, but stroke may not be altered as this would entail heavy expense for new crankshafts. Gearboxes must be from production cars. The gears may be changed, but a standard casing must be used. In this way it is possible to use the five-speed Redele-Pons gearbox used on Renault Dauphines in competitions, or a Citroen-Ersa as originally employed by Cooper. Minima are also established for wheelbase and track.

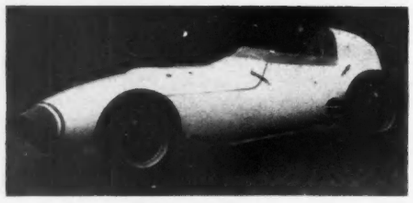
Brakes must be from the same production car as the engine. This has so far prevented the use of disc brakes. On the other hand, it may soon be possible for cars with the BMC A-type engine to be racing with disc brakes if Donald Healey succeeds in selling 1,000 of the Shorrock-supercharged Austin-Healey Sprites which are being offered with these brakes.

A roll bar is stipulated to protect the driver in the event of the car overturning. Another practical feature is the insistence on the fitting of an electric starter. The present situation on single seaters without starters is most unsatisfactory and leads to frequent disputes. A driver who spins and stalls his engine is not allowed to receive outside assistance in re-starting. If he happens to be on a slope where he can re-start with the aid of gravity he is lucky; otherwise a car in perfect condition can be eliminated from the race for lack of a push. This has led to incidents like the famous one in the Argentine when Fangio was push-started after an incident and went on to win. The local automobile club rejected protests on the ground that all persons on the track (and this happened to include Press photographers) were entitled to help competitors and this did not constitute " outside assistance."

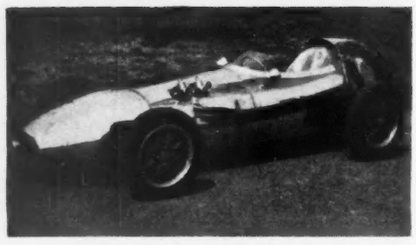
Already it is estimated that about 200 Junior cars have been built. As the formula began in Italy they have the most experience and the most successful car to date is the Stanguellini. Built with the orthodox front-engine rear-drive layout, it uses a Fiat 1,100 engine and gearbox, Fiat 1,200 front suspension and a normal rear axle with radius arms and coil springs. Basically similar is the Taraschi, except that it has a De Dion rear axle. Moretti has had some success with a very good looking rear-engined car using a Fiat 1,100 engine behind the driver, joined to a Fiat 600 gearbox and final drive unit fitted with special gears. The independent suspension is by pairs of wishbones, the lower elements of which are extended to form levers bearing on coil springs mounted near the centre of the chassis. The Maserati brothers have also entered the field with a Fiat-engined car of conventional layout. There is no restriction on carburettors, manifolds or valve sizes and most Italian constructors use the very expensive combination of two twin-choke Weber carburettors, which enables them to extract 75 to 78 b.h.p. from the Fiat four-cylinder engine.

The Germans have produced several front-wheel drive cars using the Auto-Union three-cylinder two-stroke power unit. With cylinder capacity increased to 1,082 c.c. they have been claiming power outputs as high as 80 b.h.p. A simple power plant, the Wartburg, made in East Germany has been used to equip a rear-engined car. Holland, Switzerland, Austria, Sweden and the United States are also active.

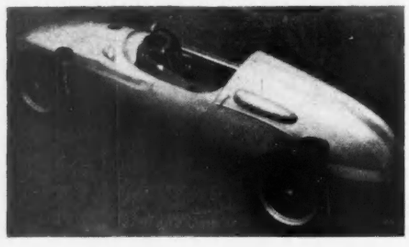
The British constructors, heavily occupied with other forms of motor racing, have only recently taken an active interest in Formula Junior. The imposition of minimum weight limits deprives them of any advantage to be obtained from their established superiority in lightweight construction but the cars already produced, the Elva, Cooper, Lola, Lotus, Halson and Gemini, should ensure strong British representation in this year's events. The two engines at present in use are the BMC A-type, which is bored out to nearly 1,000 c.c., and the new Ford Anglia 105E of 997 c.c. which with its short stroke and large bore is a very promising unit for development.



Lola

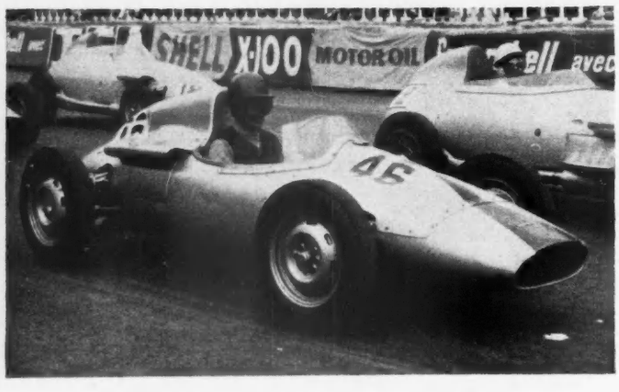


Gemini



Cooper

Stanguellini



Moretti

Human Element

Distant Early Warning for TUC

Mr. Edward Heath, the Minister of Labour, has turned down the idea that a Royal Commission on Trade Unions should be set up now. And he has done it in such a way that can leave the leaders of the Trades Union Congress in no doubt that there are no grounds for thinking the trade union world will always be left to go its own untrammelled way.

The tone of Mr. Heath's reply to the Conservative M.P.'s who asked him for such a Commission is plainly temporary. He refers to " first giving the TUC the opportunity to deal with its undisciplined minority." This minority the Minister describes as some trade union members " abusing their position."

The question that springs to mind is whether the TUC will have any more luck with its inquiry into strikes than it had with its prolonged and inconclusive duet with the Electrical Trades Union. So far it is not even clear that the TUC has managed to get Mr. Heath to understand what it is inquiring into. The TUC inquiry may have been announced after much Press attention to " wildcat " strikes; it is, however, an inquiry into not only unofficial strikes but into all strikes—strikes which just began and were later made official, and strikes which started off with official union blessing. It is this wide scope of the facts called for by the TUC chiefs that led Mr. Frank Cousins, the Transport and General Workers' secretary, to object to its impossible demands. Two other unions said the thing was beyond their capacity and the Vehicle Builders and the Woodcutting Machinists roundly declare that the authority of the TUC does not cover inquiring into their industrial disputes.

The probability is that at its next meeting later this month, the General Council of the TUC will decide to write again to the 185 unions approached—55 have not yet replied—asking them to send what information they can.

Once this has happened it is hard to see how the TUC inquiry can ever have the effect of doing for the trade union movement what a Royal Commission might; that is to say, report on current practice and make, where needed, recommendations for improvement, thus leading to a greater measure of public support for the unions.

Stings

For if the TUC writes a report that stings any of its affiliated unions in particular it will be met with a charge of partiality from its own side. If it draws up, as perhaps it well might, a report describing a situation in which personal freedom and democratic representation are seen to be commanding the field, then its critics from the right will cry " whitewash " and point out that the uncomfortable facts never reached the Bloomsbury headquarters anyway.

Mr. Heath has indicated in his letter that he is prepared to see what sort of a job the TUC makes of it. In its present impasse the TUC has no need to continue on a course leading to further loss of public confidence, and then to a Royal Commission (though it is only an assumption that all its members would dislike even that).

An independent inquiry, by uncommitted men known to the public, if the TUC's leaders would call it, would show the world that the union's top brass has courage, confidence and nothing to hide.

Lord Nelson of Marconi House

The chairman of English Electric, Sir George Nelson, told the Institution of Electrical Engineers in his Presidential address in 1957 what the fundamental requirements were in engineering.

Sir George, who becomes a baron in the New Year Honours List, thought that they were a sound knowledge of the first principles of mechanics and an intimate understanding of the properties of materials.

But the key to the man lies in the fields in which he has gathered experience—mechanical, electrical, electronic aeronautical and nuclear. A formidable list. If further explanation of the direct manner with which the chief of English Electric rules his industrial empire is sought it may lie in a personal history which includes the achievement at 18 of having obtained the diploma of the City and Guilds College, the Mitchell Exhibition and a post-graduate Brush premium studentship.

At 22, the future president of the Federation of British Industries was appointed the chief outside engineer for Brush.

Appointed managing director of English Electric in 1930, at the age of 43, he was chairman three years later.

1930's

Since then the rise of English Electric, after the difficult early thirties, to its present involvement in a massive range of industrial capital equipment, in communications, aircraft, missiles, electric traction and in well-known products in the home has gone on while, in parallel, its chairman has played the typical role of an industrial leader in public life. Typical also of his character is the field of interests for which he finds time.

A member of the governing body of the Imperial College of Science and Technology, in 1946-47 he presided over the Union of Educational Institutions. More recently he has been president of the Institution of Mechanical Engineers and of the Institution of Electrical Engineers.

English Electric have a hard won reputation as perhaps the British industrial group *par excellence* in competing for overseas orders in the multi-million pound class. It is typical that Sir George, who after the war was the first British industrialist to explore the potentialities of Russia as a market, had in 1933 negotiated with the Polish Government a £2 million contract for the electrification of the railways in the Warsaw area.

Now, after 63 years of a furiously busy life, as leader of one of the key industrial groups of a Britain facing critical problems in Europe, in the Commonwealth and in world trade generally, Sir George confronts situations as challenging as any in his long career.

Dangerous Assignment for Mr. Robens

Legendary in the tricky world of labour relations is the American trouble shooter who saw through the construction of the Fawley refinery without the slightest dislocation from stoppages.

It was achieved with much driving around the site, man-to-man talking with the men and their elected representatives, a round-the-clock on-the-spot personal contact that gave the men a feeling of being heard if they spoke up. The benefit to the contractors and their employees was obvious and considerable.

Mr. Alfred Robens, the widely respected Labour M.P., who before the last election was regarded as the likeliest possible socialist Minister of Labour, has become labour relations consultant to Atomic Power Constructions, contractors for the nuclear power station at Trawsfynydd, North Wales, and thereby exposed himself to the troubled world of construction sites and their highly paid, but mobile and therefore often rebellious, workers.

Consultant

As a consultant, Mr. Robens is responsible more for advising the company, on " ways and means " rather than directly meeting the men in the event of trouble. In the event he may wish that this should not be so, since if all goes well the credit, though real, will inevitably be rather quiet and not much recorded. If trouble should break out—as, notably at Hunterston, big and costly disputes tend to under construction site conditions—then his reputation will suffer from events over which his control is limited.

Mr. Robens has stressed that he is in a detached position, giving independent, disinterested advice, looking to the concerns of the men and the company. That, coming from Mr. Robens, is sufficient a declaration but he is accepting fees as a consultant, and that is the rock such arguments of independence will founder on in the bitter atmosphere of workers' mass meetings, should they occur.

The Trawsfynydd site, on which the company's personnel men will be dealing with some 40 unions, is likely to be as difficult as any of its forerunners have been. It is easy to agree with Mr. Robens that if the job goes through without losing time by stoppages it would be a great " prestige boost abroad," and he may well be right that it would also help the sale overseas of British atomic power stations.

Doubts

Where the doubts creep in is on the form of Mr. Robens' contact with the site. As a House of Commons man he will be at Westminster for most of the time. He has already paid his first visit to Trawsfynydd. The fact that it was a visit and not a trip on a single ticket, the return half to be bought when the job is over, is the obvious weakness.

Mr. Robens needs so to imbue the company's representatives, and the shop stewards, with what he has called his " new ideas " that all is consultation and regard for each others' problems in the intervals between his visits.

For if not Mr. Robens, then at least his political reputation *has* taken a one way ticket to Trawsfynydd. It is to be hoped that it will not be damaged by the journey.

Sit Tight for Posts at the Top

Staying with the firm offers an executive twice the chances of promotion than moving to another firm.

This conclusion, based on a survey of only 700 executives, is the more startling set against the increasing size and eagerness of the advertisements for executives, against the figures published in the Management Selection Index launched last year (ENGINEERING, p. 435, 6 Nov. '59), and on the general posting around from job to job common in so much of industry and commerce.

The 700-executive survey was conducted by the management journal *Business*, which looks over its results and concludes that the present rash of advertisements for executives has an unsettling effect. As far as conclusions can be drawn from its figures—7½ per cent of those questioned had obtained promotion by changing job in 1957-58, 15 per cent by remaining in the same firm—the inference would seem to have a calming effect. Since the journal also found that after the age of 30 there was a significant drop in the number of those gaining promotion by moving, the moral appears to be that the over-30's should settle down.

If this is accepted the lines of the week-day struggle become a little more defined. From the early 20's to 30 the acquisition of experience by moving from one company to another, from one post to another, shapes the nascent career. After 30 the road to the top is not that of well judged moves but may instead be that of treading the razor's edge to the top in the one firm.

All of which may be rather sad for the man who just likes doing his job.

Joint Iron Council Honour

Mr. Noel Newman, president of the Joint Iron Council since 1954, became a C.B.E. in the New Year Honours List.

Chairman and managing director of Newman, Hender, engineers and valve makers, which has overseas associates, notably in France and Canada, Mr. Newman is also a member of the BBC's West of England Advisory Committee and chairman of the New Cheltenham Theatre.

For ten years Noel Newman was chairman of the Council of Ironfoundry Associations and is a past-president of Institute of British Foundrymen. A member of the Engineering and Allied Employers' National Federation, he is president of the employers' West of England association.

Ground Effect Machines Grow in Number

Over the past year a number of different types of ground effect machine have appeared, among the best known being Britain's Hovercraft. However, greatest activity is in the United States.

Ground effect machines are supported on a cushion of air sealed between the base of the machine and the surface beneath it. Skin friction through water or rolling friction on land are eliminated at the expense of using power to generate the air cushion. At present the power needed to produce the cushion is lower than than required to lift a helicopter and of the same order as that required by an aircraft. It seems likely that the power can be reduced further until the power-weight ratio becomes intermediate between that of aircraft and ships. Ground effect machines are then likely to provide economic transport for loads upwards of 50 tons at 60 to 100 knots.

The four basic methods of arranging cushion air flow are shown in Fig. 2. They lead to four basic types of ground effect machine: air-bearing machines, plenum-chamber machines, labyrinth-seal machines, and annular-jet machines.

AIR-BEARING MACHINES

Air-bearing craft such as the Ford Motor Company's Levapad machines must operate a fraction of an inch above the ground. Thus the craft undersurface and the ground it travels over must be very smooth; use over water is impracticable.

Ford have produced a Levascooter and a Levacar. Both are fitted with Levapads, which provide lift. The pads, fitted on the bottom of each vehicle, are flat circular plates through the centre of which compressed air is forced. These early models have been produced for research purposes. It is likely that the first practical vehicles of this type will be adapted to rail transport.

PLENUM-CHAMBER MACHINES

The plenum chamber design is simple and eliminates most of the internal ducting typical of the other types. Air escapes from a static bell-jar type of reservoir with a *vena contracta* type of flow (that is, the air path diminishing in area). This gives a mass flow about twice that of an unrefined annular jet craft. It is possible that a critical height exists below which the plenum-chamber device is more efficient than the annular-jet type.

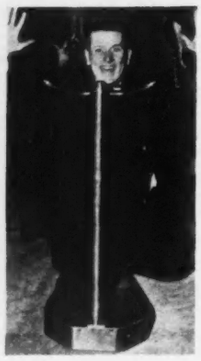


Fig. 1a

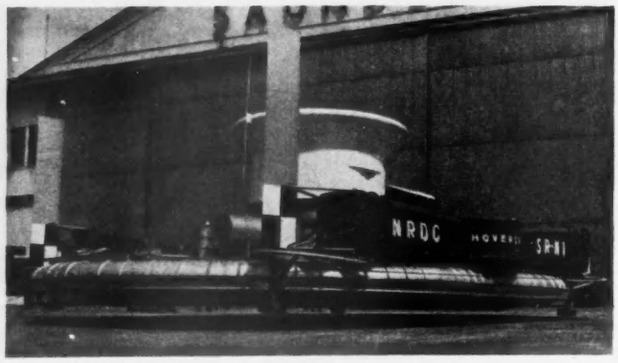


Fig. 1b

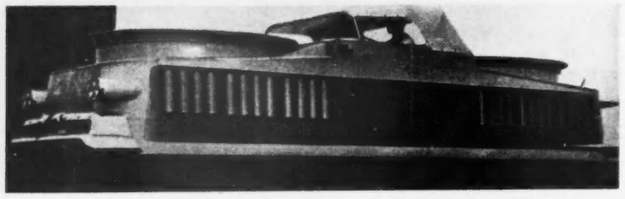


Fig. 1c

Fig. 1 Ground effect machines on land:—(a) *Ford Levascooter (air-bearing)*, (b) *Saunders-Roe SRN-1 Hovercraft (annular jet)*, (c) *Curtiss-Wright 300 h.p. Air-car (plenum chamber).*

Curtiss-Wright Corporation have developed air-cars using the plenum-chamber principle. The version shown in Fig. 3c travels about 12 in above land or water. A 200 h.p. piston engine is used to maintain the cushion, enabling a 200 lb load to be supported. A newer version, recently put on the market by the Corporation, is shown in Fig. 1c. It is a four passenger 300 h.p. type, designed to travel at 60 m.p.h. over smooth land or water. The plenum chamber operates with a cushion pressure of 15 lb per sq. ft and is fitted with a flexible skirt 8 in deep. The 3 in clearance between the skirt and the ground enables objects 11 in high to be negotiated.

LABYRINTH SEALS

The complexity of the labyrinth seal has not made it an attractive subject for initial ground effect investigations. It has, however, more scope for operation over rough surfaces than the air-bearing type, as the seals can be made flexible. A type of labyrinth-seal machine proposed by a Swiss engineer, Carl Weiland, is receiving American support and is to be developed in the USA for transport of heavy loads over water. It appears likely, however, that the flexible seals will be formed by air curtains, so that the machine will become a variation of the partitioned-cushion annular-jet machine.

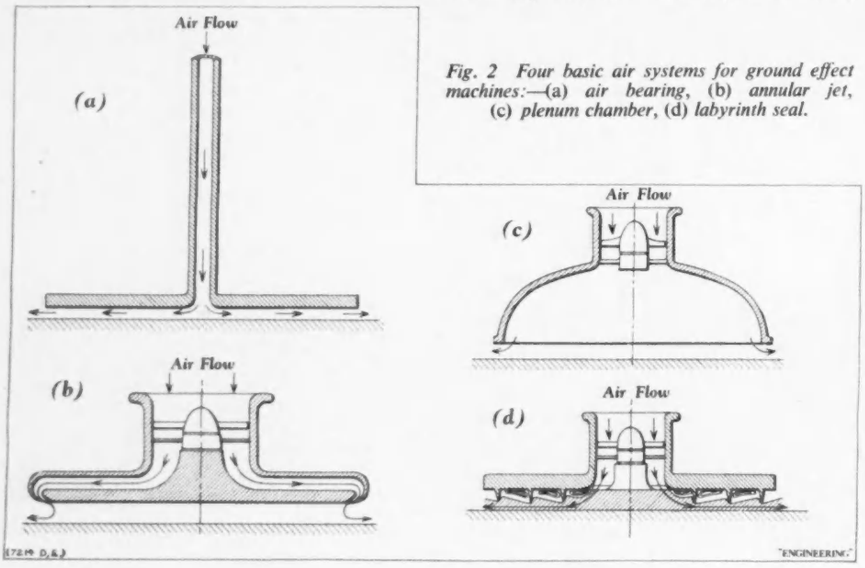


Fig. 2 Four basic air systems for ground effect machines:—(a) *air bearing*, (b) *annular jet*, (c) *plenum chamber*, (d) *labyrinth seal.*

ANNULAR JET MACHINES

The Saunders-Roe SRN-1 Hovercraft, shown in Figs. 1 and 3, was built for research purposes. An extensive description of it is given in "The Hovercraft—A New Concept in Maritime Transport," by P. R. Crewe and W. J. Eggington (read to the Royal Institution of Naval Architects). Air is drawn into a vertical funnel, by a fan driven by a 435 h.p. engine, and discharged through inner and outer annular slots under the craft, providing twin jet curtains to contain the cushion. This development from the simple curtain shown in Fig. 2 results in lower power wastage. About one-third of the air compressed is bled off into propulsion ducts to provide fore and aft motion. The craft measures 30 ft by 24 ft and has a design hover height of 1 ft. Its all-up weight is 8,500 lb and it operates with a cushion pressure of 16 lb per sq. ft. Up to 20 men have been carried at one time in overload tests.

One of the first successful ground effect machines produced in the United States was that built by Walter Crowley. His air-car is 16 ft long by 10 ft wide and is made of tubular steel covered with fabric. It weighs 550 lb empty and uses a 12 h.p. engine for lift and a 6 h.p. engine for propulsion. The cushion is contained by a peripheral curtain of air and a flexible skirt is fitted. The car travels over both land and water, but over land, objects higher than 6 in have to be avoided.

Various experimental ground-effect machines have been produced at Princeton University (Fig. 4b) and by the US Navy (Fig. 4a), who refer to their models as Skimmers. The Princeton machines have been used to evaluate various methods of control. The model shown operates with a 2 h.p. electric motor and is controlled remotely through electric cables. Research on these machines is also being carried out at the University of California and the University of Iowa. The US Navy tests are also aimed at

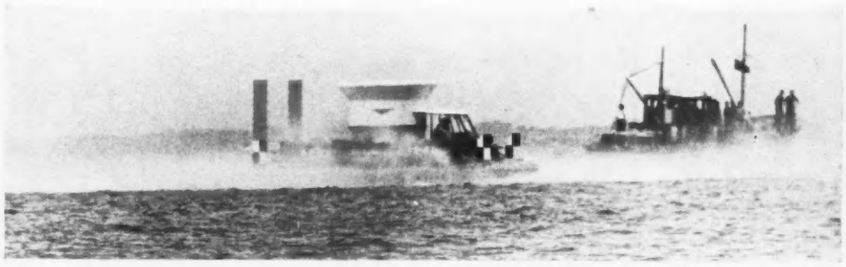


Fig. 3 Ground effect machines over water:— (a) the SRN-1 Hovercraft, (b) Crowley's 12 h.p. air-car, (c) Curtis-Wright 200 h.p. air-car.

investigating stability problems and the particular method of partitioning the cushion shown in Fig. 4a is an alternative to the concentric system used in SRN-1.

The skimmer shown is being studied by the Aero Division of the David Taylor Model Basin.

Fig. 4 Undersides of experimental machines:— (a) US Navy Skimmer, (b) Princeton University electrically powered saucer.

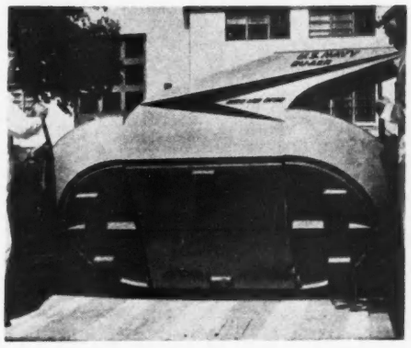


Fig. 4a

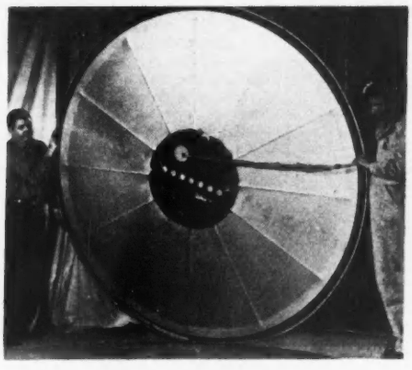


Fig. 4b

Fig. 5 Three future ground effect machines:— (a) Pegasus-1 air-car, (b) Levapad rail car, (c) 400 ton annular jet machine.

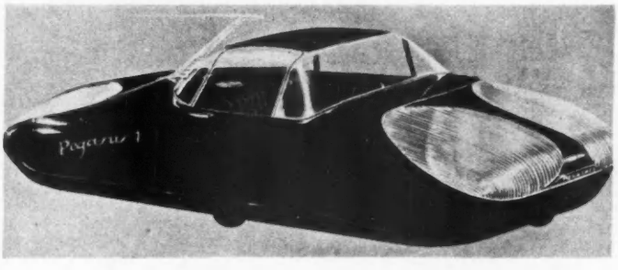


Fig. 5a

Fig. 3a

It is part of a coordinated technical investigation incorporated in the US Defence Programme, which includes hydrodynamic investigations by the Office of Naval Research and the Navy Bureau of Aeronautics and Ships.

FUTURE DEVELOPMENTS

Some of the models that have been put forward as likely developments in ground effect machines are shown in Fig. 5. The rail vehicle shown is possibly the first likely application of the air-bearing principle for public transport. The two-passenger Pegasus 1 is an 850 lb air-car planned for production by National Research Associates, Washington. It is designed for travel about 2 ft above ground and is equipped with wheels for landing. The large twin-engined vehicle is envisaged as a 400 ton successor to the SRN-1. It would be used as a cross-channel ferry, carrying 800 passengers and 80 cars. An installed power of 40,000 h.p. would give an operating height of 4 ft at 90 knots.

American activity in this field is rapidly increasing. Several large firms, including General Motors, Ford, Curtiss-Wright, Convair, Martin, and Bell, are undertaking engineering investigations of the possibilities offered. A number of smaller firms are also active, including Aerophysics Company and Spacetronics Incorporated. The latter has received a military contract for a plenum-chamber craft and has a 275 h.p. craft under construction that is designed to carry eight men at a speed of 85 knots. The same company is reported to be constructing a commercial vehicle of 55,000 lb all-up weight for cargo service to the Bahamas.

In Britain, Hovercraft Development Limited are planning to develop a 40 ton machine. An important problem in the development of hovercraft is the reduction of the power required by the air curtain. Achievement of this is also likely to alleviate the spray and dust that operation of SRN-1 has shown could be a nuisance in civil applications. There is, however, ample evidence to show that spray will present no problem at cruising speeds of 50 knots or more.

Development of suitable power plants and of automatic control systems to stabilise flight over rough water are further problems that must be solved before the true value of ground effect machines can be assessed. Hovercraft represent the application of aircraft techniques to marine transport, and this in itself is a development problem of some complexity.

Fig. 3b

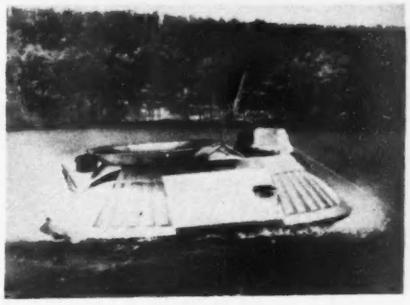


Fig. 3c

As far as marine transport is concerned, the large hovercraft machines will be in competition with large cargo-carrying submarines. And this competition will not be settled solely on economic grounds. There is the difficult question of which type of marine transport has the greater strategic value.

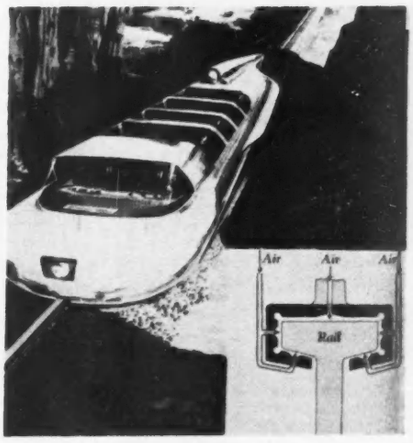


Fig. 5c (above)

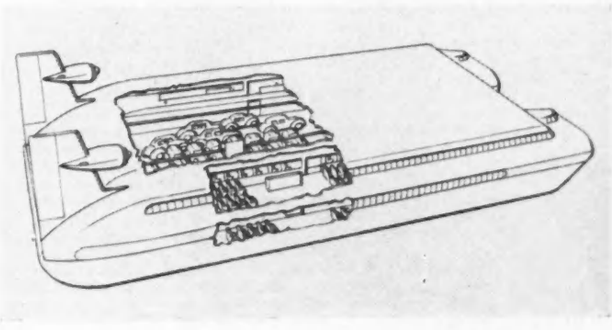


Fig. 5b (below)

PUSH BROACHES

For Close Tolerance Bores

A RANGE of standard diameter push broaches has been produced for making close tolerance holes on a production basis.

The broaches are made from 18 W high speed steel to precision limits to produce "U" tolerance holes. They are designed to broach a nominal size drilled pilot hole, the final size and starting dimensions being shown on each broach. As they are made in large numbers the price has been kept low and they are therefore an economical proposition. Their introduction extends the range of keyway and square broaches already available.

The cutting angles on the broaches as supplied are made correct for steel, but are such that the broaches can be used for brass, aluminium alloy, cast iron and other metals. It is advised, however, that the same broach should not be used for different materials as the ultimate surface finish will deteriorate. Since the ideal arrangement of design for each application is not possible with standard

broaches, the pitch of the teeth has been chosen to cover a wide range of material thicknesses, and lists of recommended sizes are given. Although thinner parts can be stacked to provide sufficient length of hole, the maximum thickness should not be exceeded.

Nominal sizes of broaches in the range are from $\frac{1}{16}$ in to 1 in in increments of $\frac{1}{32}$ in. For the smaller sizes the tolerance is $+0{\cdot}0006$ in $-0{\cdot}0000$ in and in the largest it is $-0{\cdot}001$ in $+0{\cdot}000$ in The broaches are available separately or packed as sets. *W. H. Marley and Company Limited, 105 High Road, New Southgate, London, N11.*

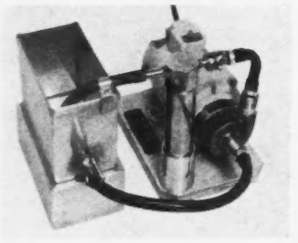
FILTER

For Ultrasonic Cleaners

FOR the continuous removal of solid matter from ultrasonic cleaning baths the type 1181 filter has been introduced.

Fluid is drawn from the bottom of the cleaning bath by a centrifugal pump and returned to the top of the bath by way of a filter which has a robust sintered element of stainless steel. This is capable of removing all solids down to below 2 microns size with a flow rate up to 8 gallons of liquid per hour. There are seven other grades of filter with pore sizes that will allow flows up to 60 gallons per hour.

Removal of an element for cleaning or for changing to one of different pore size takes less than a minute. The cylindrical filter housing is unscrewed from its cap to reveal the filter element, which can then in turn be unscrewed and removed. The filter housing is held in a spring clip on the wooden base board. The overall dimensions of the unit including the pump and the 200 W motor are 12 in by $6\frac{1}{2}$ in by 10 in high



and the all-up weight is about 15 lb.

All metal parts in contact with the cleaning fluid are of stainless steel. The interconnecting tubing is of tough extruded nylon. All parts are therefore easily cleaned and can be sterilised if required.

Larger filters are available which can also include temperature control of the cleaning fluid. Although designed primarily for use with all types of ultrasonic cleaners these units can be used satisfactorily for all filtration applications. Their use removes the expense and nuisance of frequent changing of the cleaning fluid. *Dawe Instruments Limited, 99 Uxbridge Road, London, W5.*

NON-SYNCHRONOUS TIMER

Weld Control

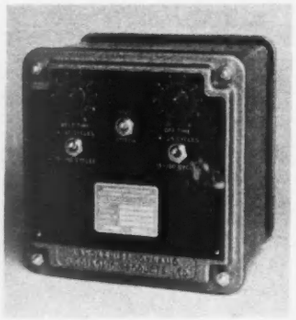
SOME new models have been added to the Lancashire Dynamo range of resistance welding control equipment.

These are multi-stage non-synchronous timers which have been designed to provide a compact and inexpensive assembly suitable for building into resistance welding machines, and which incorporate switching arrangements for air valves and electromagnetic or ignitron contactors.

There are three basic units in production for two, three or four stages of time control. Typical control sequences that can be obtained are: weld — forge; weld — hold — off; and squeeze — weld — hold — off; all with facilities for single or repetitive spot operation.

The two stage model illustrated offers a choice of weld time from 4 to 150 cycles and the same range of idle time. There is also a choice of spot and stitch welding.

The four stage unit allows a pressure-before-weld sequence and enables the conventional pressure switch to be



omitted if this should be considered desirable. A very high rate of repetitive spot welding has been achieved with this timer and welding rates of 180 spots per minute have been maintained with reliable results. The units have been designated the series RCW25 and will operate from standard mains supplies. They are equipped with multi pin sockets for connecting up. *Lancashire Dynamo Electronic Products Limited, Rugeley, Staffordshire.*

SIDE LOADER

Transporting Long Sections

AVAILABLE in this country are the Baker Traveloaders designed for handling and transporting long sections.

The range includes three large models with capacities of 20,000 lb, 30,000 lb and 50,000 lb. The TKF300 as shown has a capacity of 30,000 lb at 39 in centres. The vehicle is stabilised by four diagonally extending jacks that are hydraulically operated. These obviate the need for heavy balance weights during the loading and unloading operations.

The Traveloader has an overall length of 27 ft 3 in and a width of 8 ft. The standard lifting height is 12 ft and the height of the hoist assembly when the load is raised is 16 ft 6 in; with the load lowered the height is 10 ft 6 in. The mast can be tilted backwards or forwards through an angle of 5°.

Power is supplied by a Hercules diesel engine which develops 132 b.h.p. at 2,400 r.p.m. The drive is taken through an Allison torque converter. The vehicle

can exert a draw bar pull of 17,000 lb. The driving speeds range up to 20 m.p.h. in either forward or reverse travel. The hydraulic brakes are by Hydro-Vac and operate on all four wheels. The hydraulic system is powered from a Hydreco gear displacement pump delivering 30 gallons per minute at 1,000 lb per sq. in when it is running at 1,200 r.p.m.

The driver's cab is totally enclosed and the controls are so arranged that the driver can face in either direction. A dual cab for a mate can be fitted at the rear if desired. *Materials Handling Equipment (Great Britain) Limited 40a Dover Street, Piccadilly, London, W1.*

PINION HOBBER

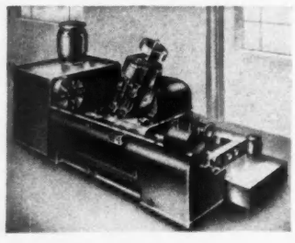
12 in Capacity

THE model P12H hobber has a capacity for cutting double helical pinions up to 12 in diameter with a face width of 30 in and a maximum shaft length of 80 in.

Chief claims for the machine are its rigidity and extreme accuracy. All body castings that affect the precision are pearlitic iron, stress relieved. The dividing worm wheel is 20 in in diameter and has 150 teeth at fine pitch. These have a low pressure angle to give the maximum number in contact with the worm. The wheel is made of phosphor bronze and the worm of nickel molybdenum steel, case hardened and ground.

The lead screw is a free-cutting carbon steel and is 4 in diameter. It is mounted near the locating V guide of the hob saddle. The screw is subjected to normalising and stress relieving during production. Axial location of the screw is by case hardened, ground and lapped-flat thrust washers located at the end of the screw.

The compound nut assembly which is



mounted on the hob slide comprises two separate nuts widely spaced. One of these is permanently mounted and the other is arranged so that it can be rotated (by means of a worm and wheel) relative to the fixed nut and so eliminate backlash. The differential gear comprises casehardened and profile-ground spur gears mounted on ball bearings. Permanently mounted measuring equipment is incorporated in the machine as well as detachable dividing plates.

The machine is provided with motor-operated rapid traverse for the hob saddle for use when setting up, and limit switches at extreme positions to prevent overrun. *David Brown Industries Limited, Sherborne Street, Manchester.*

CONCRETE MIXER

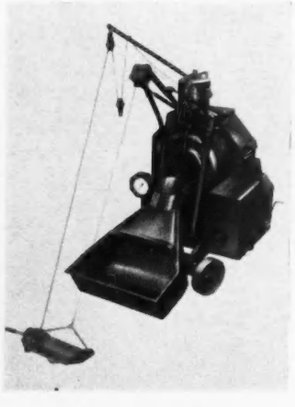
Reversing Drum on Non-Tilting Mixer

RECENTLY introduced is a $\frac{1}{2}$ cu. yard reversing drum non-tilt concrete mixer.

It is claimed that the 14 NT/R machine will produce even very dry mixes without balling, and in a short mixing time. It has been designed to load easily on to the standard Lolode trailer. Another claim is that the discharge height of 4 ft 6 in allows the concrete to be discharged into any make of normal placing equipment, whether dumper, hopper or conveyor.

Movements of the hopper under hydraulic power are said to give positive finger tip control. The hopper has an angle of discharge of 55° to ensure quick charging of the drum. The hydraulic ram is designed to eliminate the possibility of damage to the weigher on the downward movement.

All the controls can be grouped on either the right or left hand side as required; this arrangement allows one operator to attend to two machines with a common feed from a batcher. For



individual use the machine can be fitted with an accurate built-in batch weigher, and for quick loading a large capacity drag scraper can be included. The control valve for the water allows partial discharge into the drum before the dry materials are introduced. *Winget Limited, Rochester, Kent.*

TEMPERATURE CONTROLLER

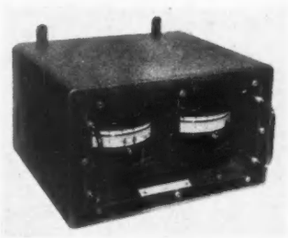
Down to − 100° C

A NEW design of temperature controller gives precision indication and control down to temperatures below − 100° C.

The instrument is available with stepless, proportioning and on/off control and is suitable for a wide range of operating temperatures in the low temperature field. Chief claims are for compactness; direct supply from mains; and the elimination of manual adjustment for voltage variation. For corrosion protection the instruments are installed in an air purged gasketed glass fronted cabinet.

A built-in rectifying and stabilising unit is fed direct from the alternating current mains instead of from a battery, eliminating corrections to compensate for battery deterioration and allowing a very compact size to be achieved. The frontal measurements of the resistance on/off controller are only 7½ in by 6¼ in.

It is claimed that for small changes in temperature there is a substantial change



in current enabling a robust movement to be installed without loss of sensitivity or accuracy. The scale can be set for an artificial zero. It is also claimed that the instrument is not susceptible to changes in ambient temperature and will continue to work satisfactorily at 130° F. It can be used at considerable distances from the point of measurement. A typical application is for measuring the temperature difference between the inlet and outlet temperatures of generator cooling water. Three-position controllers with two setting pointers are used; the first sounds a klaxon and the second shuts down the set. *West Instrument Limited, 51 Regent Street, Brighton, 1.*

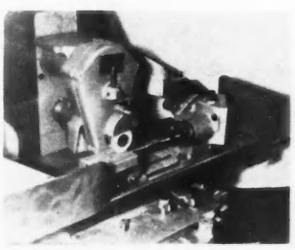
SPLINE GRINDER

Automatic Indexing

THE machine illustrated is a standard model 540 surface grinder with a spline grinding attachment.

The attachment allows the radius at the bottom of four splined shafts to be ground with a formed wheel, and by automatically indexing the component through 90° each time the machine table moves to the right the grinding wheel is brought clear of the splines. As the clearance is limited, a small diameter wheel is used and a high speed attachment carrying a 2½ in diameter wheel is fixed to the wheel head in place of the normal size wheel.

The work is mounted on centres between a tailstock at the left-hand side of the table and an automatic indexing head on the right. The indexing head is actuated by a cam mounted on the side of the wheel head column which contacts a ratchet lever and indexes the work spindle through 90°; a plunger engaging an index wheel retains the spindle in position during the grinding



operation and a driving plate on the front of the index head spindle engages a driver attached to the work.

To enable the components to be loaded between centres with the bottom of the spline in the correct relation to the wheel, a loading device is used which ensures that the driver is correctly positioned for the purpose.

A wheel trueing device is included consisting of a mandrel carrying a diamond set to the required radius, which can be mounted between centres. Setting collars are provided to enable the diamond to be set to the required degree of accuracy. *A. A. Jones and Shipman Limited, Narborough Road South, Leicester.*

LOCKER UNITS

with Racks and Hangers

A RANGE of free standing locker units combined with hangers and racks has been evolved by Oostwoud Fabrieken of Utrecht.

The " Multilok " consists of vertical steel units with either six, ten or twelve compartments, each of which can be locked and which are designed to take small personal articles. Attached alongside are hat and shoe racks and a rail from which are suspended coat hangers. These last are attached to the rail by means of knobs that fit into a specially designed slot and so always remain evenly spaced ensuring that damp clothes are not crowded together. The hangers cannot be used apart from the special rails and therefore do not tend to " disappear " from the locker room.

It is claimed that the lockers only take up a very small floor space and, being free standing, can be rearranged at any time to suit requirements. It is also stated that owing to the free view that is possible across the locker room the risk of petty pilfering is greatly reduced. The

units are finished in stove enamel and are available in a wide range of colours. They are quickly and easily interchangeable. The small size and small floor area allow a large number to be accommodated in a comparatively small room. *Vaz Dias International N.V. 91-93 Singel, Amsterdam, Netherlands.*

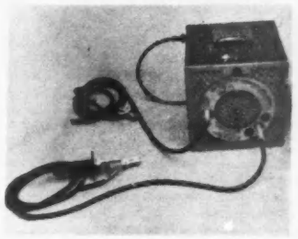
PORTABLE ARC WELDER

Heavy Duty

THE Fararc model 240 is a toroidal welding transformer unit with improved insulation that allows it to be used on heavy gauge rod without overheating.

The unit is contained in a steel and aluminium case weighing in all 84 lb and measuring 14 in along each side. Open circuit voltage is 50 volts and the current range is from 60 to 300A with a maximum continuous rating of 200A. The standard model has a double-wound primary for 200/250V and 400/440V, but special windings for other supplies are available. The efficiency is high, giving a power factor of 0·82 and the magnetising current is under 1A. No correcting condensers are needed and the unit has been approved by the Electricity Boards for use on rural mains.

The windings are insulated to class H using double glass wrapped where necessary with woven glass cloth, the whole being triple impregnated with pure silicone varnish and baked. This insulation is said to withstand temperatures up



to 180° C without damage. Cooling is by a fan which passes 600 cu. ft of air per minute over the windings and as an additional precaution there is a thermostatic switch which in the event of overheating cuts off the welding current but leaves the fan running, so that the set will cool down rapidly.

A single unit will take electrodes from 14 to 4 s.w.g. and will weld steel up to 1 in thick. It will also cut steel up to ½ in thick. A 15A 230V supply is sufficient for using 10 s.w.g. electrodes. Units may be connected in parallel to give outputs up to 600A. *Portable Welders Limited, Castle Mills, Buckingham.*

SECTION STRAIGHTENER

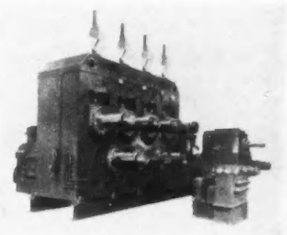
Joists up to 18 in by 6 in

A SEVEN-ROLL straightening machine has been developed which will take rolled steel joists up to 18 in by 6 in, channels up to 17 in by 4 in, angles up to 8 in by 8 in by 1 in, and flat bottom rails up to 105 lb per yard.

The power for the drive to the bottom straightening rolls and to the vertical spindle pinch rolls at the exit end of the machine is supplied by a 150 h.p. motor. This is direct coupled to a two-speed totally enclosed reduction gearbox which gives pass speeds of 100 and 180 ft per minute.

The machine body is made of heavy steel fabrications into which steel castings for the bearing housings are welded. All parts are stress relieved. The straightening roll shafts are made of alloy steel and are mounted in massive roller bearings.

The top roll shafts are mounted in substantial chocks. Vertical and axial adjustments are carried out by geared motors. Large indicator dials on the top of the machine show the vertical



settings of the top rolls. The reversing drum controller for the main motor, the forward and reverse push button starters for the vertical and axial top roll adjustments and for the pinch roll setting, are all mounted on a control desk that can be placed at some position convenient to the operator from which he can easily observe and control the operation of the machine.

The reduction and distribution gears are spray lubricated; the roll shaft bearings run in oil, and other bearings are grease lubricated by means of a Farval manual system. *Joshua Bigwood and Son Limited, Wednesfield Road, Wolverhampton.*

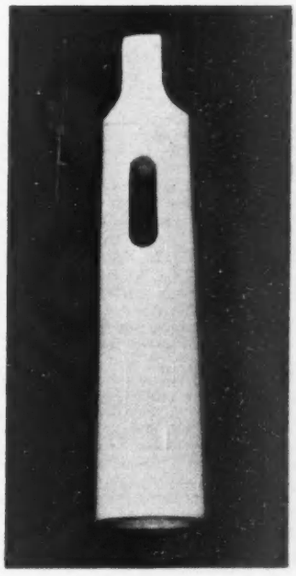
MORSE TAPER SLEEVES

Moulded Nylon

MOULDED nylon morse taper sleeves now available protect the tool shank and holder from abrasion and ensure good fit.

The tough plastic takes up jars and knocks as well as any slight discrepancies in the shape of the tool shank or the machine socket. Being a little elastic the grip is maintained over the entire length. Another property is that the sleeves are resistant to corrosion so can be used with all water-soluble cutting oils without fear of rusting. They can also stand up to damp storage conditions without deterioration.

If dropped, the sleeves will not damage workpieces or machine beds if they fall on them, and any small pieces of swarf can be absorbed in the material without risk of damaging either shank or holder. A long life is claimed. The sleeves are made in six sizes with the following degrees of taper: 2/1; 3/2; 3/1; 4/3; 4/2; and 4/1. *Insley Industrial Supply Company Limited, 21-22 Poland Street, London, W1.*



FEED CONTROLLERS

Electropneumatic Operation

Now available is a range of electro-pneumatically operated slides for the control of feed from hoppers or from conveyors.

A typical slide consists of a mild steel shutter moving across a square aperture formed by four members of a robust steel framework. The basis of this framework is a modified channel section whereby parallel fixing flanges are provided both upstream and downstream of the slide. The web of this channel is offset on its centre line presenting a sealing surface against which the shutter bears under the restraint of two parallel guide rods. These guide rods being circular in section and being swept by each movement of the shutter virtually eliminate the problem of build-up of material and present little obstruction to what is otherwise a completely free discharge opening.

The framework is extended to form the mounting for a push-pull pneumatic cylinder and its associated solenoid operated pilot valves, the piston rod

being direct coupled to the shutter. Remote indication of the shutter position is given by a limit switch, rod operated, which is adjustable to suit a wide range of conditions. Adjustable air cushioning is provided at the extreme positions of the pneumatic cylinder allowing fast opening and closing of the shutter without the occurrence of shock at the end of its travel.

All moving parts other than the limit switch are within the framework boundaries so that complete enclosure can be carried out to suit actual applications. The slides are made in six standard sizes ranging from 4½ in by 4½ in to 18 in by 18 in. They are available as single units or as part of complete installations. Special sizes and dust proof models can also be obtained. *Lindars Automation Limited, 143 Maple Road, Surbiton, Surrey.*

SPRAY EQUIPMENT

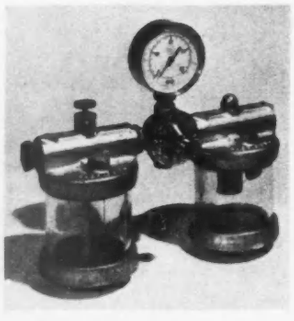
For Cutting Oils

An oil mist unit has been introduced for the purpose of spraying cutting oils on to faces being machined.

The unit enables soluble or neat oils and coolants to be fed to the work face in circumstances where surface speed normally makes dry machining necessary. With the increase in speeds that the introduction of new types of tools has made possible this problem has recently become more acute. The unit functions by delivering a fine mist of coolant in a stream of compressed air aimed directly at the point of cutting.

The working pressure of the equipment is from 10 to 20 lb per sq. in. There are three major components: a porous bronze filter element; a pressure reducing valve complete with gauge to indicate the reduced air pressure (that is the pressure of the air as used for the spray); and an Ayrlyne lubricator fitted with a flow adjustment.

The lubricator embodies a transparent oil reservoir with a needle regulating



valve to control the oil flow. The ratio of oil to air can be adjusted by a regulating screw at the top of the lubricator to suit the particular operation. There are two sizes of oil reservoir holding one-half, and one pint, respectively.

The model M3892 unit is suitable for use with neat cutting oils of a viscosity not exceeding 300 secs Redwood at 70° F, or with soluble oil emulsions. *Wakefield-Dick Industrial Oils Limited, Castrol House, Marylebone Road, London, NW1.*

TAPPING MACHINE

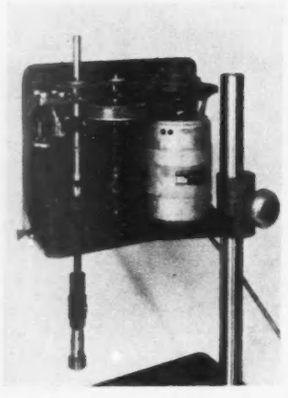
High Accuracy Threads

Milman multiple pitch tapping machines are now being marketed in this country.

Using one hardened and ground master leadscrew these machines will tap all commonly used BA and BSF threads up to $\frac{3}{16}$ in. Other pitches provided by the standard change wheels are 32, 36, 40, 44, 48, 56, 64, 72, 80 and 96 tpi. Special gears are available for 90, 120 and 200 tpi.

The complete tapping head is adjustable for height on the column and the table has a 10 in by 6¼ in working surface. The spindle is driven by a ¼ h.p. instantaneously reversible motor through a friction clutch and a 5 : 1 belt reduction. The feed rate of the tapping spindle is governed by the relative rates of rotation of the master leadscrew and its matching nut. It can be changed by selecting a pair of change gears and choosing a cluster gear combination. Changes can be made very quickly.

Spindle stroke is adjustable from ⅛ in to 2 in and is governed by limit switches.



These in turn are protected by mechanical safety devices. Spindle speed is infinitely variable. Control is by foot switch or push button, the spindle reversing automatically at the preset point. *Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

TRACTOR CRANE

Detachable Unit

A light hydraulically operated crane has been produced for general industrial work using a tractor as the power unit.

The Arley crane is designed for mounting on the front of a Fordson Major tractor, but is supported by its own wheels. These are linked to the steering of the tractor so that the whole can be positioned very accurately and simply by the driver. The maximum load is 15 cwt.

The jib is raised and lowered by a single acting ram operated from the tractor valve block. The lift is 24 ft giving a clearance under the hook at full height of 22 ft 6 in. With the jib in the down position the travelling height is 15 ft 10 in and the minimum height (jib horizontal) is 14 ft 4 in. The overall width of the crane unit is 7 ft 9 in and the length with the jib down 19 ft 3 in. The maximum lifting radius is 11 ft 9 in.

The tyres on which the crane is mounted are 750 by 16 8 ply, and as

mentioned earlier the wheels are steered by direct linkage from the tractor front wheels. It is stated that the crane can be attached to or removed from the tractor in about 15 minutes. The hydraulic power for operation is derived from the hydraulic system of the tractor and works at 2,000 lb per sq. in. Precision lowering of the load can be obtained by the use of the valve lever, and exact positioning by the full view allowed the driver. *Witlor Limited, 107-109 Lancaster Street, Birmingham 4.*

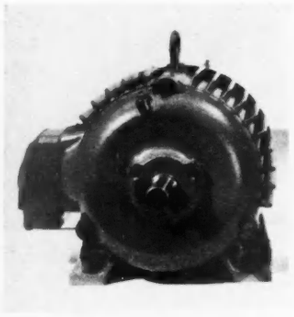
TOTALLY ENCLOSED MOTOR

Output Doubled

A new range of fan cooled totally enclosed electric motors has twice the output for the same frame size as existing models.

Known as the type D, they are wound with class E insulation allowing a temperature rise of 65° C above ambient. The result is that for example the 40 h.p. type D has the same frame size as the 20 h.p. type B, the earlier fan cooled totally enclosed design. The motors are designed for all industrial applications particularly where there is dirt and dust in the atmosphere.

Special features include a cast iron exterior, a plastic non-corrosive fan, a weatherproof terminal box, and drain holes with detachable plastics plugs. There are 12 frame sizes covering 2-pole machines from 1½ to 30 h.p.; 4-pole from 1 to 40 h.p.; 6-pole from ½ to 25 h.p.; and 8-pole from ½ to 20 h.p. They can be wound for operation on 2 or 3-phase supplies up to 650 volts at 50 or 60 cycles as standard. Starting



torque is 200 per cent full load at 700 per cent full load current.

High torque motors for special applications, and motors for any other frequencies as 25 or 40 cycles can be supplied. Models will be available for foot, flange, or skirt mounting, pad and air stream rated. As the dimensions are the same as the existing type C range of ventilated motors the two are interchangeable. *English Electric Company Limited, Marconi House, Strand, London, WC2.*

MAGNETIC SEPARATOR

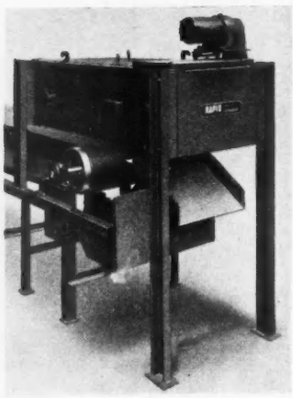
For Fine Mesh Materials

The APS is a magnetic separator designed particularly for handling large throughputs of fine mesh material containing a high proportion of magnetic particles.

The separator is an alternate pole unit consisting of a self-discharging electro or permanent polarity magnet unit suspended at the terminal end of a short-centred conveyor. A hopper with a jig shaker feeder is provided, and dividers are incorporated at the point of discharge for collection of both a high grade non-magnetic fraction and also a middling product if these two are required in addition to the final separation product obtained from the machine.

Where feed conveyors are already installed the overband magnetic unit can be offered separately. The illustration shows such an installation.

Typical applications for which the machine can be used are the recovery of magnetite from crushed ore, the separation of steel shot from scale, and the recovery of iron from crushing fines in



slag processing plants. Throughputs of up to 30 tons per hour are possible on a machine measuring 18 in wide. The particles are given a severe agitation after pick-up to ensure a clean high grade magnetic fraction. *Rapid Magnetic Machines Limited, Lombard Street, Birmingham 12.*

Euroscope

An overgrown nuclear industry such as exists in Europe today can only be sustained by an economic programme of power generation—or generous government subsidies. Research contracts alone cannot justify the deep commitment of heavy industry found in the United Kingdom, France, Germany, and Scandinavia. An odd dilemma faced the industrial powers of Europe when it was realised that nuclear energy might not become competitive for some time. In order to benefit from the application of nuclear energy perhaps ten or fifteen years hence, it was essential to undertake a programme of development and construction of a magnitude beyond the capabilities of any profit-conscious organisation. National nuclear energy programmes were drawn up in many countries to provide the necessary incentive to private industry. But incentive of this type is just another form of subsidy, which, like all subsidised ventures, causes a diversion of industrial effort from profitable fields of development. It is a long-term gamble for very high stakes, based on an uncertain horoscope.

Industrial Federations Confer

Last May the industrial federations in the OEEC countries, which includes the FBI, sponsored a Conference at Stresa on the industrial prospects in nuclear energy. The conference was organised by ENEA (European Nuclear Energy Agency) and the EPA (European Productivity Agency). The proceedings are now being published by OEEC in four volumes. The first, entitled *The Industrial Challenge of Nuclear Energy* is now available, price 18*s* 6*d*.

Survey of European Programmes

There are three main jobs required for nuclear development, whether carried out by international organisations such as ENEA, CERN, IAEA, and Euratom, or by national governments. These are the preparation of programmes, coordination, safety controls, and general supervision; pure research and personnel training; and the industrial activity of equipment manufacture, power plant construction and operation. Britain and France are the leading European countries in all three fields, while the Dragon project at Winfrith Heath, sponsored by OEEC, is an outstanding example of international cooperation. The programme of power plants now in operation or under construction in Europe is concerned with four main types of reactor. These are:

(*a*) Natural-uranium, graphite-moderated.
(*b*) Uranium oxide and heavy water.
(*c*) Enriched uranium and pressurised water (PWR)
(*d*) Enriched uranium and boiling water (BWR).

Outside these categories are the 15 MW(e) fast neutron breeder reactor at Dounreay, the 20 MW(e) high temperature reactor of the Dragon Project, and the various organic moderator projects for small stations and ship propulsion.

Evaluation of Competitive Bids

The World Bank is interested in nuclear energy as a means of helping member countries "to develop their economic strength." In Europe it has financed, with the Italian Government, the construction of a 150 MW(e) nuclear power plant in South Italy, known as Project ENSI. The Bank set up an International Panel which studied nine tenders submitted for the scheme. These included bids from AEI-John Thompson, GEC-Simon Carves, Mitchell Engineering Company, London, and English Electric. The tenders were examined by "a complex procedure affording the best possible safeguards of impartiality." A report giving a full technical and economic analysis of each tender was prepared as a basis for the final decision of SENN, the body responsible for the power plant. One interesting conclusion by the Panel was that differences in price between various models of the same type of reactor are greater than differences between reactors using natural or enriched uranium.

The cost calculations of Fig. 1 for the types of power station in the tenders are based on a capacity of 150 MW and a load factor of 80 per cent. The price variations were based on a 14 per cent rate of capital amortisation which gave a price per kWh of the most economical nuclear station on tender of 11·1 mill per kWh with an additional 10 per cent variation from the cost of the hypothetical traditional station.

The "most suitable and economically attractive project" of those submitted proved to be that of the International General Electric Company of New York. The cost per kWh was estimated at between 7 and 9 lire, and total output at 1,000 million kWh a year. Italian industry is putting up 70 per cent of the capital cost, namely 28,000 million lire.

First-Generation Nuclear Power Stations

Britain, France, USA and USSR are the only countries now operating commercial nuclear power stations. For Britain the gas cooled, graphite-moderated reactor was a logical choice following the development of reactors for the production of plutonium and given the high cost of producing uranium-235. America, which can produce uranium-235 easily in areas of cheap electricity, has developed light water-moderated systems using enriched fuels. In Britain considerable effort is going into the development of the fast-breeder reactor to use the quantities of plutonium produced in the thermal stations.

Federal Germany

The Federal German Republic has no state nuclear programme comparable to those of Britain and

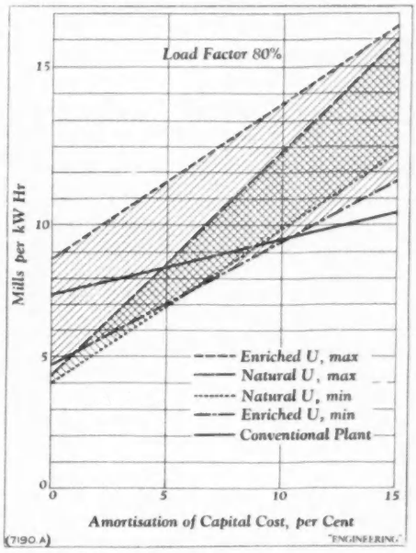


Fig. 1 Comparison of generating costs, which served as a basis for the selection of tender for the SENN station. Interest charges were 14 per cent.

France. Current expenditure on research is borne by the Federal Government, the Länder and the Municipalities. Reactors of various kinds with a total output of 500 MW(e) will be constructed by 1965. They will include a gas-cooled graphite-moderated reactor of the British type, and an advanced gas-cooled high temperature "Potato Heap Reactor" (Atomic Review, 11 Sept. '59). Germany has no immediate energy problem so that the object is to experiment with developments that will make it possible to produce nuclear energy at a competitive price by about the mid 1960's. The amount being spent on these schemes is assessed at over DM 2,000 million. In principle the execution of the whole programme is in the hands of private industry, as the Federal Government neither constructs nor operates nuclear installations. In practice aid in the form of subsidies to reduce financial risk will be given to the firms involved. Very few scientists and technicians involved in nuclear development are employed directly by the Federal Government. Most of them belong to the universities, the Max Planck Society and similar institutions.

The French Programme

In France the first reactor ZOE went critical in 1948. The first plutonium producing reactor G1 started operating in 1956, followed by G2 in 1958 and G3 which became critical in 1959. Together these reactors are planned to produce 100 kg of plutonium a year with a by-product electric generating capacity of 60 MW. The first French power station designed primarily for electricity production will be the EDF1 station at Chinon. The reactor there will be of the natural uranium, graphite-moderated and gas-cooled type, with a capacity of 63 MW. Other installations included in the French first five year plan were the plutonium plant at Marcoule, the construction of the EL3 pile, the building of the 2·5 GeV proton-synchrotron "Saturn" and a natural uranium production capacity of some 300 tons a year. The first five year plan cost 100,000 million francs. In 1957 a second five year plan was started entailing expenditure of 235,000 million francs. This covers an isotope separation plant and further work on graphite-moderated power stations. Electricité de France has built a power station EDF1, and a second, EDF2, is under construction.

French Nuclear Budget

Practically all the money for the French programme comes from the state controlled Commissariat à l'Energie Atomique (CEA). Up to the end of the second five year plan in mid 1962 a grand total of at least 500,000 million francs will have been spent or earmarked for nuclear energy projects. Within this round figure are the capital investment of Electricité de France (EDF) and Frances's contribution to Euratom and OEEC research undertakings as well as the budget of CEA. At the end of 1958 CEA had a staff of 10,715 of whom 1,968 were university graduates working as scientists, engineers or administrators.

Power for Italy

In Italy public finance is allocated to nuclear research but not to reactor programmes. The National Committee for Nuclear Research (CNRN) is the Government body responsible for apportioning and supervising state funds for nuclear research. CNRN operates various centres and laboratories including the National Synchrotron Laboratory at Frascati, the Nuclear Studies Centre at Ispra, the Casaccia Nuclear Studies Centre, the Nuclear Health and Safety Laboratory at Naples University and the Mars Spectrometry Laboratory at Rome University. In addition CNRN finances the National Institute of Nuclear Physics (INFN) which directs basic research in the universities, and organises geological and mining research and prospecting teams working in Italy. It also collaborates in research projects on prototype power reactors with Italian industry and is involved in the training of scientific and technical staffs. CNRN has a five year plan (1957-62) for the development of atomic research in Italy which, will cost 50,000 million lire.

Heat for Sweden

Demand for electricity in Sweden is increasing at the rate of 5 to 7 per cent a year, and is likely to do so for the next ten to fifteen years. Present electricity supplies are mainly from hydro-electric plants. By the 1970s it is expected that about 500 MW(e) per year of non hydro-electric capacity will have to be installed. Electric power is provided in about equal amounts by the State Power Board and the AKK Group consisting of private and municipal utility companies. Several industrial concerns such as the ASEA Group, the Bofors Group and the Johnson company are interested in nuclear power development. It is expected that 75 per cent of components needed will be made in Sweden under licence agreements. Reactor development is being concentrated on natural-uranium heavy-water moderated systems. The first Swedish installation is the design and construction of a space-heating plant in Stockholm called R3-Adam. This reactor, which should be critical in 1962, is being jointly constructed by A.B. Atomenergi, the State Power Board and ASEA.

The Norwegian Programme

The Norwegian nuclear energy programme is carried out by the national Institute for Atomic Energy (Institutt for Atomenergi) at Kjeller, set up in 1948 by an agreement between the Government and the industrial firm Norsk Hydro. An interesting development is the Joint Establishment for Nuclear Energy Research (JENER) set up in 1951 by the atomic energy organisations of Norway and the Netherlands. Most of Norway's nuclear activity has been within the framework of JENER. The annual Norwegian budget is about $3 million a year. Norway has no immediate energy problem and effort is being concentrated on the development of a suitable form of power reactor. A ship propulsion project costing some $500,000 million is being financed by the Government and shipowners. The ENEA Halden joint project for a boiling heavy-water reactor near Oslo, designed and built by the Norwegian Institute for Atomic Energy, was carried ou

with the participation of a number of international and national organisations including the UKAEA.

Summary of European Programmes

Britain and France, as the only two European powers with military as well as non-military programmes, spend far more on nuclear development than any of the other European countries. In EMA units of account Britain has an annual research programme costing 400 million units and France 200 million units. In both these countries the atomic energy sector is nationalised, and therefore operated on lines which "are less narrowly preoccupied than private industry with immediate return." On the whole, however, development in the European countries has followed substantially parallel lines. Fundamental research has proved so costly that in all cases it has been taken over by national governments. This has been followed by the stage of applied research in which State and industry have collaborated in semi-public undertakings. The so-called "extra-mural" contracts placed by the UKAEA with private industry fell into this category. Fig. 2 shows the sites of nuclear development in Europe.

Problems for the Future

Two kinds of problem arise. First, on the basis of costs, the programmes described at the Conference add up to 8·5 million kW by 1965. This will cost nearly $530 million a year, or about $2,800 million by 1965. This represents a very considerable sum to find. Second, there is the problem of the gap between the cost of nuclear and conventional energy. This problem could be postponed by simply not investing in nuclear energy for the present. But this would mean Europe falling behind in the scientific and technical fields. The short term surplus of conventional energy must not be allowed to hold up long-term development of nuclear resources.

These are problems which will be solved in different ways by the various countries. In Britain and France the nuclear power station programme will go on even though the stations will show a temporary deficit. Elsewhere national governments are likely to be increasingly brought into nuclear programmes. This is true of Italy and Germany and even in Switzerland, where the constitution inhibits Federal Government action. In Switzerland interest free loans will be made to private firms involved in nuclear research schemes.

Notes and News

Hidden Costs of Nuclear Power

Estimating the cost of nuclear power generation is a risky occupation. This truism led someone to remark at the Stresa conference that the most important factor affecting the estimated price of nuclear power is the author of the study. Mr. J. R. Cuthbertson, of Lazard Brothers, pointed out two factors which seriously affect the cost of nuclear power, but which are commonly disregarded. It is unrealistic to compare the cost of conventional and nuclear power generation based on plants operating with the same load factor, because in order to maintain a high load factor on the nuclear plant some conventional stations of excellent economy will have to operate at load factors as low as 40 or 50 per cent. Further, if at a later stage during the nuclear plant's 20 years of life some conventional plants of even higher efficiency come into operation, those being built today—on which the cost comparison is now based—will be operated at an even lower load factor at a later date. The resulting losses are not commonly charged against the nuclear station.

False Assumption

Another false assumption is the belief that the high load factor on nuclear stations can be maintained throughout the plant's life. If it is believed that nuclear generating costs will also drop within the next 20 years—which is the cardinal assumption of our whole nuclear energy programme—then the base load now allotted to the first generation of nuclear stations will have to be shared with the more efficient new plants. The operator will then be forced to give preference to efficiency and will find it impossible to maintain the high load factor that originally served as the basis for estimating the generation costs. But a variable or falling load factor is now thought to be an unnecessary elaboration of an estimate that is unreliable in any case. Mr. Cuthbertson warns against the illusion that a nuclear power programme will be able to pay for itself: it will be costlier than generally thought.

Fig. 2 Location of nuclear research centres, fabrication plants and projects in OEEC countries.

Fuel for the Reactors of Europe

The International Atomic Energy Agency (IAEA) disposes of 5,070 kg of uranium 235, contributed by the United States (5,000 kg), Russia (50 kg) and the United Kingdom (20 kg). Finland has now made the first formal request for reactor fuel from the IAEA for a Triga Mark II research reactor and a proposed critical assembly. The uranium 235 requirement of the two reactors will be about 5·6 kg, costing some $896,000 at current domestic prices in America.

A second charge of fuel has been ordered for the boiling heavy-water reactor at Halden, Norway. The first fuel charge consisted of metallic natural uranium and was suitable for zero power operation of the reactor. Addition of a few "spiked" (or enriched) elements will raise the power to 5 MW, but full design level of 20 MW can only be reached with a new charge of fuel enriched to 1·5 per cent. 1,500 kg of the enriched fuel has been ordered from AB Atomenergi of Sweden at a cost of $500,000.

Westinghouse Reactor Core for Belgium Critical

The pressurised water reactor core Westinghouse is supplying for the Belgian power station at Mol has been completely assembled in the company's reactor evaluation centre in America and brought to criticality. During January extensive testing is planned to prove the reactor's characteristics. Later the core will be dismantled for shipment and re-erected at Mol. When completed, the station will feed 11·5 MW(e) to the Belgian transmission system.

Status of Construction at NPD-2

The construction schedule for Canada's 20 MW(e) power demonstration project NPD-2 was drawn up to permit installation of mechanical equipment during the winter months. Structural work on the reactor building and pump house is virtually complete so that the installation of moderator and coolant pipes could be started under cover early in December. First components of the generating equipment arrived at the site 20 miles from Chalk River in November and installation has just begun. The construction force will be maintained during the winter months at its present strength of 230 men.

Something for the Winner of the Proton Stakes

A bottle of Russian vodka stood for a long time on the desk of Mr. J. B. Adams, director of the CERN proton synchrotron division. The label said "to be used after reaching 10·1 GeV," and was given to Mr. Adams by workers at Dubna, home of the 10 GeV accelerator which was the "world's largest" not so long ago. The bottle, now empty, is on its way back to Dubna—with an oscilloscope trace showing a 24 GeV pulse, reports the *CERN Courier*.

Valves for the AGR

Safety valves for the advanced gas cooled reactor (AGR), under construction at Windscale, have been ordered by the UKAEA from Cockburns of Glasgow. The valves will protect the carbon dioxide coolant circuit against excess pressure and are designed to open at 280 lb per sq. in. The operating temperature of the valves is 760° F. Cockburn valves are also on order for Bradwell, Hinkley Point and Hunterston.

Merger of NPPC and AEI-John Thompson

Collaboration between the nuclear consortia of NPPC and AEI-John Thompson, announced in Atomic Review on 21 August, 1959, has resulted in the formation of a new company, The Nuclear Power Group (abbreviated TNPG). The group will comprise the following companies: AEI, Clarke Chapman, Alexander Findlay, Head Wrightson, Sir Robert McAlpine and Sons, C. A. Parsons, A. Reyrolle, Strachan and Henshaw, John Thompson, and Whessoe Limited, with headquarters located at Radbroke Hall, Knutsford, Cheshire. Two partners will each have three representatives on the board of directors under the chairmanship of Viscount Chandos. TNPG have three power station contracts running: Bradwell (300 MW), Berkeley (275 MW) and Latina (200 MW).

'Engineering' Appointments Section

PUBLIC APPOINTMENTS

LOUGHBOROUGH COLLEGE OF TECHNOLOGY

Applications are invited for the position of HEAD OF PRODUCTION ENGINEERING, to take charge of both the Department of Industrial Engineering and the Production Engineering Workshops.

Applicants should be well qualified academically in Mechanical Engineering, have had extensive industrial experience, and, preferably, have had particular responsible experience in Industrial Engineering, in either manufacturing or research fields.

Since the College Workshops operate both as an instructional factory, and as laboratories in industrial engineering, the post offers very great scope for new developments.

The salary will be according to the scale £2450 by £50 to £2700 per annum. The post is pensionable.

Further particulars and application forms may be obtained from the REGISTRAR, (In reply please quote 19/D.) B 11

PORT OF BRISTOL AUTHORITY

TWO ENGINEERING ASSISTANTS

Applications invited for posts concerned mainly with Civil Engineering Design and candidates should be capable of preparing schemes with minimum of supervision from initial survey through calculations and preparation of drawings to final contract documents. Experience in dock engineering useful but not essential.

Salary £1065 by £50 to £1220 per annum. Commencing salary within this range will depend upon age, qualifications and experience. Post pensionable; medical examination and six months probationary period.

Applicants must disclose whether they are related to a member or senior officer of Bristol Corporation. Canvassing disqualifies.

Applications stating age, qualifications, experience, etc., and enclosing, if possible, copies of recent testimonials, in envelopes endorsed "Engineering Assistants" to ENGINEER-IN-CHIEF, AVONMOUTH DOCKS, BRISTOL, by 30th January. B 10

D.S.I.R.

D.S.I.R. Tropical Products Institute, London, requires MECHANICAL ENGINEER (graded as Scientific Officer or Senior Scientific Officer) for development of new processes for production and utilisation of tropical plant and animal materials. Occasional trips abroad. Quals.: 1st or 2nd class hons. degree in mechanical engineering or equivalent. Sound theoretical knowledge and ability to design pilot plant and equipment and supervise construction essential. Experience in agricultural engineering, chemical plant or heat engines an advantage. Salary ranges: (men) S.O. £655-£1150. S.S.O. £1233-£1460.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C.875/9A. Closing date 29 January, 1960. B 5

CIVIL ENGINEER

ROAD RESEARCH LABORATORY (D.S.I.R.), Harmondsworth, Middlesex, requires CIVIL ENGINEER (Scientific Officer/Senior Scientific Officer) to conduct research on design and construction of earthworks for roads. Qualities required are initiative, energy, appreciation of broad issues, some mathematical ability, pertinacity in pursuing research to practical issue and ability to build up and lead small team. Work urgently concerned with nation's road programme but also has wider applications in field of civil engineering. It provides contact with other engineers, chemists, physicists and mathematicians. Facilities for qualifying for A.M.I.C.E. Quals.: 1st or 2nd Class Hons. degree in Civil Engineering or equivalent. A sound knowledge of soil mechanics would be an advantage. Salary ranges: (men) S.O. £655-£1150; S.S.O. £1233-£1460. Entry point in salary ranges dependent upon experience. Normal prospects of promotion in mid-thirties to Principal Scientific Officer (£1500-£2120).—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting E.529/9A. Closing date 15 January, 1960. B 4

POST OFFICE

ASSISTANT ENGINEER

About 10 permanent and pensionable posts for men at least 17½ and under 23½ on 1.3.60, with extension for Forces service, Overseas Civil Service, and, up to two years, for established civil service. Written examination, beginning 5.4.60, in English, Physics and two prescribed optional subjects, followed by interview of qualified candidates. Salary (London) £566 at 18, 19, or 20, £620 at 21, £785 at 25 or over, rising to £1205. Five-day week in general. Promotion prospects.—Write CIVIL SERVICE COMMISSION, BURLINGTON GARDENS, LONDON, W.1, for application form, quoting 159/60. Closing date 28 January, 1960. B 3

AIR MINISTRY

AIR MINISTRY Works Designs Branch requires in LONDON—STRUCTURAL ENGINEERING DESIGNER DRAUGHTSMEN for reinforced concrete or structural steelwork of all types. Applicants must have adequate training and several years' experience. Some site experience and possession of recognised technical qualification an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 working days leave per year initially.

Salary for Grade III ranges from £680 (at age 25) to £900 p.a. Commencing salary dependent on age, qualifications and experience. Also vacancies in higher grade for suitably qualified candidates on range from £895 to £1055 p.a. Applicants, who must be natural born British subjects, should write to AIR MINISTRY, W.C.1., LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or to any Employment Exchange (quoting Order No. Kings Cross 3745) giving age, details of training, qualifications, full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 842

VACANCIES FOR

TWO ENGINEERING CLERKS

Applications are invited for these two vacancies on the staff of the CHIEF RESIDENT ENGINEER of several large pipelaying contracts in Lanarkshire.

The duties of the successful applicants would include the maintenance of filing systems, checking interim and final certificates of Contractors, copy typing and general office routine.

Previous experience of engineering works office routine would be advantageous.

It is anticipated that the appointments would be for about 18 months.

Salaries would be £600 per annum.

Written applications, with age and full particulars, should be addressed to the Chief Resident Engineer, Daer Water Scheme, c/o The Clerk to the DAER WATER BOARD, P.O. BOX No. 1, LANARKSHIRE HOUSE, 191, INGRAM STREET, GLASGOW, C.1, not later than 20th January, 1960. Interviews by appointment will be held in Glasgow during the first week in February. A 900

UNIVERSITY OF SYDNEY

LECTURESHIP/SENIOR LECTURESHIP IN MECHANICAL ENGINEERING

Applications are invited for the above position.

The salary for a SENIOR LECTURER is within the range £A2200-£A80-£A2600 per annum; for a LECTURER within the range £A1500-£A90-£A2100 per annum. In each case cost of living adjustment will be allowed. The salary is subject to deductions under the State Superannuation Act. The commencing salary will be fixed according to the qualifications and experience of the successful applicant.

Under the Staff Members' Housing Scheme in cases approved by the University and its Bankers, married men may be assisted by loans to purchase a house.

Further particulars and information as to the method of application may be obtained from the SECRETARY, ASSOCIATION OF UNIVERSITIES OF THE BRITISH COMMONWEALTH, 36 GORDON SQUARE, LONDON, W.C.1.

Applications close, in Australia and London, on 2nd February, 1960. G 839

Hawker Siddeley Aviation LIMITED

DYNAMICS

The above Group of the undermentioned Company require the following technical personnel:—

(a) VIBRATION ENGINEER

To investigate the behaviour of mechanical systems to applied vibration derived from complex sources. This work involves the measurement of vibration transmission through complex structures, the determination of resonant modes, and the effects of vibration on the performance of guided weapons.

Applicants should possess a University Degree in Physics, Mechanical or Electrical Engineering, and preferably some experience in this field.

(b) A TECHNICAL ASSISTANT

for work similar to that described above.

Applicants with H.N.C. in Mechanical or Electrical Engineering are preferred but consideration will be given to candidates with lesser qualifications if suitably experienced.

(c) ENGINEER (Instrumentation and Control)

To be responsible for the operation and adjustment of electrical control equipment fitted to climatic test chambers. This work involves the regulation of electrically operated control instruments and valves required to maintain the performance of the test chambers within close operational tolerances. Design of specialised control equipment for particular test requirements may be involved as testing techniques develop.

Applicants should possess H.N.C. or equivalent, together with a good knowledge of automatic systems, refrigerating machinery and air conditioning equipment.

Initial salaries are arranged according to age, qualifications and experience, and progress is related to merit and ability.

The positions are permanent, and successful candidates will be eligible for the Hawker Siddeley Group Pension Scheme and Life Assurance Scheme after a qualifying period.

Applications stating age, qualifications and experience, should be addressed to:—

Technical Appointments Officer,
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LIMITED,
Baginton, Nr. Coventry

Quoting Reference: TAO/DYN/3 B2

ENGINEER

required by

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKSHIRE

To be responsible to a senior engineer for supervision of teams of inspectors engaged on measurements, and inspection of a wide variety of complex experimental and prototype equipment. The duties include supervising the inspection of assemblies required for environmental and vibration testing, and designing measurement jigs and fixtures.

Applicants should be Corporate Members of a Senior Engineering Institution or possess similar qualifications. They should have had a sound training and experience in inspection techniques. Some design experience is desirable.

SALARY: £1345-£1800.

Contributory Superannuation Scheme. A house, or substantial assistance with house purchase, will become available for married officers living beyond daily travelling distance.

Postcards for application forms to the SENIOR RECRUITMENT OFFICER at above address. Please quote ref. 2488/26. A 974

A.E.R.E. HARWELL

requires

DRAUGHTSMEN

for work covering electronic, electrical, mechanical and instrumentation equipment and chemical plant connected with reactors.

Salary: In range £585—£1120 p.a.

Housing and superannuation schemes.

Send POST CARD for full details to **GROUP RECRUITMENT OFFICER (1553/26), U.K.A.E.A., A.E.R.E., HARWELL, BERKS.** A 972

THE HARLAND ENGINEERING CO. LTD.

ALLOA, SCOTLAND

is expanding its activities in the manufacture of Centrifugal Pumps, Electrical Rotating Machinery and Hydro Electric Plant and

FIRST CLASS DRAUGHTSMEN

are required for senior appointments in the drawing office for:

CENTRIFUGAL PUMP LAYOUT

Senior draughtsman with experience of large single and multistage pumping plant.

WATER TURBINE LAYOUT

Senior draughtsman with experience of Francis, Impulse and Kaplin turbines.

ELECTRICAL ROTATING MACHINERY DESIGN

Senior draughtsman with experience in mechanical design of electric motors and generators.

Conditions of service in pleasant residential area and modern office, include 39½ hour week, contributary pension scheme, canteen facilities and extended holidays after 12 months.

Write giving full particulars of age, qualifications, experience etc., to the **Chief Draughtsman, B.E.P. Works, Alloa, Scotland.**

A 984

DESIGN DRAUGHTSMEN

are required by Company engaged in the manufacture of Hydraulic Loading Shovels. Applicants must be able to work with the minimum of supervision on a wide range of subjects which include Transmission, Hydraulics, Chassis Design, Welded and Cast Structures. These positions demand originality and versatility and applications will only be considered from Designers who are prepared to work at a high tempo. H.N.C. minimum qualification.

Apply in writing to Chief Designer, stating experience, qualifications, age, salary, etc.

F. E. WEATHERILL LIMITED
TEWIN ROAD,
WELWYN GARDEN CITY
Telephone: Welwyn Garden 4221

A 996

Esso

Have a vacancy in London for a graduate

MECHANICAL ENGINEER

preferably under 35 years of age, an Associate or Graduate Member of the Institution of Mechanical Engineers.

Good practical training and design and construction experience on heavy engineering work is desirable. This position offers opportunities for training, experience and advancement on work of considerable diversity in the development of new projects and operations.

Starting salary will depend on age, experience and qualifications. There is a contributory Pension Plan, and Sickness and Accident Benefit Scheme.

Applications quoting Ref. M.E.2, giving full personal details should be sent to:—

MANAGER,
RECRUITMENT & TRAINING,
16 CHARLES II STREET,
HAYMARKET, S.W.1

A 997

VICKERS-ARMSTRONGS (ENGINEERS) LIMITED

BARROW-IN-FURNESS

DESIGN ENGINEERS AND TECHNICIANS

A number of Design Engineers and Technicians are required, having experience in the design of Boilers, Turbines, Auxiliaries and Marine Installations. Applicants should possess a University Degree or equivalent qualification. Experience on steam machinery of advanced design would be an advantage.

These appointments are for work in connection with machinery for Tankers, large Passenger Liners, Naval Craft and Nuclear Powered Vessels. Salaries appropriate to experience and responsibility are offered, and there is a contributory Pension and Life Assurance Scheme.

Barrow-in-Furness is pleasantly situated on the coast adjacent to the Lake District. The Company has a well-appointed Sports Club and Grounds, with comprehensive recreational facilities both social and sporting. An illustrated guide to the town and surroundings can be sent on request.

All applications should be addressed to the:

ENGINEERING TECHNICAL MANAGER,
VICKERS-ARMSTRONGS (ENGINEERS) LIMITED,
NAVAL CONSTRUCTION WORKS, BARROW-IN-FURNESS, LANCASHIRE.

B 1

NEW ZEALAND

MINISTRY OF WORKS ENGINEERING STAFF

The New Zealand Ministry of Works invites applications for the following vacancies on the Permanent Staff. Positions, qualifications desired and salaries offered are as follow:—

Vacancy No. 1. CIVIL ENGINEERS. Corporate Membership of the Institution of Civil Engineers, London, together with sufficient appropriate experience. Commencing salaries up to £1525 per annum.

Vacancy No. 2. ASSISTANT CIVIL ENGINEERS. A University Degree in Civil Engineering, or Graduate Membership of the Institution of Civil Engineers, London, with at least five years of practical experience since commencement of pupilage. Commencing salaries £870 up to £1060 per annum.

Vacancy No. 3. MECHANICAL OR ELECTRICAL ENGINEERS. Corporate Membership of the Institutions of Mechanical or Electrical Engineers, London, together with sufficient appropriate experience. Commencing salaries up to £1525 per annum.

Vacancy No. 4. BUILDING SERVICES ENGINEERS. Corporate Membership of the Institution of Heating and Ventilating Engineers, London. Commencing salaries up to £1450 per annum.

Vacancy No. 5. ASSISTANT MECHANICAL OR ELECTRICAL ENGINEERS. A University Degree in Mechanical Engineering or Graduate Membership of the Institutions of Mechanical or Electrical Engineers, London, together with at least five years experience since commencement of pupilage. Commencing salaries £870 up to £1060 per annum.

Vacancy No. 6. ASSISTANT BUILDING SERVICES ENGINEERS. Graduate Membership of the Institution of Heating and Ventilating Engineers, London, with at least five years experience since commencement of pupilage. Commencing salaries £870 to £1060 per annum.

Civil Engineers and Assistant Engineers must have had experience in the design or construction of multi-storied reinforced concrete buildings or bridges and other structures. For the other vacancies experience is necessary in the design and installation of services or equipment for one or more of the following: heating and ventilating, air conditioning, hot and cold water or sewerage services, laundries, kitchens, boilerhouses, lifts and other mechanical services in offices, schools, hospitals, hotels, telephone exchanges, printing works, defence establishments, etc. All appointees will be required to undertake work of this nature.

APPLICANTS MUST BE RESIDENT IN THE UNITED KINGDOM OR EIRE AND HAVE FULFILLED NATIONAL SERVICE OBLIGATIONS.

Enquiries, mentioning this publication and stating the Vacancy Number and the position sought, should be addressed to the HIGH COMMISSIONER FOR NEW ZEALAND, 415 STRAND, LONDON, W.C.2. Full details of duties, experience required, general information on the conditions of employment in the New Zealand Public Service and application forms will then be supplied.

A 980

THE UNIVERSITY OF LIVERPOOL

Applications are invited for the following posts in the Department of Civil Engineering:—

TWO POSTS OF LECTURER. The initial salary will be within the range £900-£1350 per annum, according to age, qualifications and experience.

DEMONSTRATOR. The initial salary will be within the range £600-£650 per annum, according to age, qualifications and experience.

Applications, stating age, academic qualifications and experience, together with the names of three referees, should be received not later than 24th February, 1960, by the REGISTRAR, from whom further particulars of the conditions of appointment may be obtained. Quoting Ref. CV/E.

A 987

CHEMICAL PLANT DESIGN ENGINEERS

are required at Risley to control sections responsible for the design of large projects.

The work will include novel and conventional mechanical and chemical engineering problems arising from the use of special materials and will involve, for example, provision for the remote operation of plant and equipment and design of associated laboratories and services. Specialisation in any one aspect is not intended.

Applicants must have served a recognised engineering apprenticeship and be corporate members of a senior engineering institution or equivalent. Considerable experience of high quality chemical engineering design is essential and an honours degree in mechanical or chemical engineering may be an advantage.

Salary within range £1370 to £1825 according to qualifications and experience.

Posts at a higher level with salaries up to £2180 may be available from time to time.

Contributory superannuation.

Staff housing scheme.

Send postcard for application form, quoting reference 147/J2 to:—

Recruitment Officer,
UNITED KINGDOM ATOMIC ENERGY AUTHORITY
(DEVELOPMENT AND ENGINEERING GROUP),
Risley, Warrington, Lancashire.
Closing Date: 18th January, 1960.

A 971

AUSTRALIA

STATE DOCKYARD, NEWCASTLE NEW SOUTH WALES

ESTIMATOR, thoroughly experienced in both ship construction and general engineering work, e.g. power station condensing and feed heating plant, etc., required.

Education standard to Degree, Diploma or Higher National Certificate level with Naval Architecture preferably as major subject.

The State Dockyard constructs and repairs all classes of cargo and passenger vessels up to 500 ft., including tugs and dredging craft.

Commencing salary up to £1644 (Aust.) per annum according to qualifications and experience. Superannuation and Profit Sharing Schemes in operation.

Passage to Sydney will be arranged for successful applicant and temporary living accommodation available.

Applications close with the AGENT GENERAL, NEW SOUTH WALES GOVERNMENT OFFICES, 56 STRAND, LONDON, W.C.2, by 31st January, 1960.

A 993

CITY AND COUNTY OF BRISTOL

EDUCATION COMMITTEE

THE COLLEGE OF TECHNOLOGY

(DESIGNATED AS A COLLEGE OF ADVANCED TECHNOLOGY AS FROM SEPTEMBER, 1960)

The Governors invite applications for post of LECTURER IN MATHEMATICS, duties to begin as soon as possible.

Applicants should possess an honours degree in Mathematics or Statistics and have teaching and research or industrial experience involving application of mathematics to scientific and engineering problems. Preference to candidate with experience in statistical work.

Salary, 1959 Burnham scales:—
Men: £1370-£1550. Women: £1293-£1461 (including equal pay increments).

Placing on scale will depend on approved industrial and teaching experience.

Application form, returnable by 30th January, and details from REGISTRAR, COLLEGE OF TECHNOLOGY, ASHLEY DOWN, BRISTOL, 7.

A 975

CITY OF NOTTINGHAM

WATER DEPARTMENT

APPOINTMENT OF CIVIL ENGINEERING ASSISTANT

Applications are invited from Engineering Graduates and/or Corporate Members of the Institution of Civil Engineers for the permanent pensionable appointment of a Civil Engineering Assistant. Salary, dependent upon qualifications and experience, in the special grade for Engineering Assistants (£785 by £40's (6) by £45 to £1070).

Applications, with names of two persons to whom reference may be made, to ENGINEER AND GENERAL MANAGER, WATER DEPARTMENT, CASTLE BOULEVARD, NOTTINGHAM, not later than the 25th January, 1960.

T. J. OWEN,
Town Clerk.

THE GUILDHALL,
NOTTINGHAM

B 17

WELSH COLLEGE OF ADVANCED TECHNOLOGY

CATHAYS PARK, CARDIFF

Principal: A. HARVEY, Ph.D., B.Sc., F.Inst.P.

Applications are invited for the post of LECTURER IN PRODUCTION ENGINEERING

Salary: £1370-£1550 per annum, with placing upon the scale dependent upon experience.

Applicants should be Graduates or Associate Members of the Institution of Mechanical Engineers and the Institution of Production Engineers and have had sound industrial experience.

Further particulars and form of application, which should be returned not later than Friday, 22nd January, may be obtained from the Principal.

ROBERT E. PRESSWOOD,
Clerk to the Governors.

CITY HALL,
CARDIFF.

A 999

DRAUGHTSMAN

Applications are invited for the above post, which is located in Birmingham.

The work is interesting and varied and is mainly in connection with the design of industrial heating equipment. A knowledge of combustion technique and the use of refractories would, therefore, be an advantage.

Candidates should possess the Ordinary National Certificate in Mechanical Engineering as a minimum qualification.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £733-£853 per annum.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the INDUSTRIAL RELATIONS OFFICER, WEST MIDLANDS GAS BOARD, 6, AUGUSTUS ROAD, EDGBASTON, BIRMINGHAM, 15.

G 841

SHEFFIELD CORPORATION

WATERWORKS

YORKSHIRE DERWENT SCHEME

Applications are invited for the following appointments on the staff of the Waterworks General manager and Engineer (A. B. Baldwin, M.Eng.):—

(*a*) CHIEF ASSISTANT ENGINEERS, i/c Sub-sections. Salary J.N.C. Scale "A" (£1215-£1445). Two vacancies.

(*b*) SENIOR ENGINEERING ASSISTANT. Salary APT. V (£1220-£1375). One vacancy.

Successful applicants will be engaged upon the design and construction of the works of the Yorkshire Derwent Scheme, comprising a River Intake and Treatment Plant, a 40-mile Aqueduct, Service Reservoirs, Pumping Stations and Plant

Applicants must be Chartered Engineers experienced in design and construction of major works. Previous employment on similar water supply schemes would be an advantage.

Appointments are superannuable and subject to medical examination and to the national conditions of service as applied by the City Council.

Applications endorsed with the title of the post applied for are to be forwarded to the undersigned by 23rd January, 1960, stating age, qualifications, past and present appointments (with dates and salaries), details of relevant experience and schemes engaged upon, together with the names of two referees.

JOHN HEYS,
Town Clerk.

TOWN HALL,
SHEFFIELD, 1. A 992

APPOINTMENTS OPEN

REPRESENTATIVES

REPRESENTATIVES wanted for correspondence abroad, high earnings, written instructions.
Write: FORTUNA PUBLISHING CO., VIENNA 1/8, POSTFACH 40, AUSTRIA. G 824

DESIGN ENGINEER

Midland Firm requires a DESIGN ENGINEER in the field of gas compressors. Good academic qualifications are essential to cope with the wide range of engineering problems encountered. This post carries responsibility with excellent opportunities in a company where personal contact is made with all departments at all levels.—BOX A989, Offices of ENGINEERING.

ENGINEERING STAFF REQUIRED

BIRLEC-EFCO (MELTING) LIMITED, the recently formed and rapidly expanding company associated with Birlec Limited (an A.E.I. Company) and Efco Limited, leading British Furnace Manufacturers, have vacancies for DESIGN ENGINEERS. Applications are invited from Engineers whose professional qualifications lay emphasis on such subjects as mechanics, strength of materials, theory of structures, etc. These should be supported by practical training in industry and experience in the design of medium or heavy structures and mechanisms. Whilst actual furnace experience is not expected, applicants should be able to deal with fundamental mechanical engineering problems arising in the design of Arc Melting, Smelting and Induction Furnaces. A knowledge of basic electrical engineering would be an advantage. Preferred age 25-35. Good prospects of advancement, non-contributory Retirement System.

Apply: BIRLEC-EFCO (MELTING) LIMITED, WESTGATE, ALDRIDGE, STAFFORDSHIRE. A 988

DESIGNER DRAUGHTSMAN

The Production Manager of a modern Light Engineering Factory in Shannon, Ireland, immediately requires a

FIRST CLASS DESIGNER DRAUGHTSMAN

The applicant must be up to the H.N.C. standard and have had workshop training, together with experience in light engineering design.

Write in the first instance to the Production Manager, giving full details of career, salary required, etc., to BOX A 994, Offices of ENGINEERING.

LINGUIST

LINGUIST required for technical work with a large engineering firm. The languages chiefly required are FRENCH, GERMAN and SPANISH, and applicants should submit precise information regarding their ability in this direction, together with technical qualifications, age and full details of any past experience to "T.T." VICKERS-ARMSTRONGS (ENGINEERS) LTD., BARROW-IN-FURNESS. A 986

CROGGON & Co., Ltd.,

have vacancies for

STRUCTURAL DRAUGHTSMEN

The posts are permanent and pensionable.

Write stating age, experience, qualifications and salary required to

Poyle Steelworks, Colnbrook, Nr. Slough, Bucks. B12

MSL *have been retained to advise on the appointment of a*

SENIOR DESIGNER

for a company manufacturing centrifugal pumps.

The Senior Designer will join an experienced team of six engaged in creative design work, and will co-operate in a consultant capacity with other departments, with customers and with subcontractors.

Candidates should be experienced in the creative design of centrifugal land pumps or in their applications; or alternatively in hydraulic turbines, hydro-electric or power-station equipment. A B.Sc., A.M.I.Mech.E. or A.M.I.C.E. qualification would be acceptable provided it includes the study of hydraulics.

Preferred age 40 to 48 years. Initial salary in the range £1500 to £2000, with pension and life insurance.

Please send brief details in confidence, quoting reference F.2104, to J. G. Smith. In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment.

MANAGEMENT SELECTION LIMITED
212, West Regent Street, Glasgow, C.2
B 25

DEVELOPMENT ENGINEERS

required by a leading instrument manufacturer in South East Essex for work on further application of a major project.

SENIOR ENGINEER

preferably a PHYSICIST aged about 30 years, with a good degree, to act as deputy to the laboratory head in the administrative and technical fields. Good knowledge of engineering and optics are essential while some electronic experience and interest in photography would be an advantage. Starting salary within the range £1200/£1700 according to age, experience and qualifications.

PROJECT ENGINEERS

preferably PHYSICISTS and MECHANICAL ENGINEERS, with a minimum qualification of H.N.C., for work involving mechanical engineering and design, electrical design and the mechanics of optical and photographic systems. Starting salary within the range £850/£1150 according to age, experience and qualifications, with ample scope for future progress.

A contributory pension scheme and life assurance arrangements are available and housing assistance may be arranged in suitable cases after a satisfactory probationary period.

Adjacent Central Line and other public transport services.

Applications, which can be made in the strictest confidence, should give full particulars of qualifications, previous experience and salary required and be addressed to BOX B 8, Offices of ENGINEERING.

MECHANICAL ENGINEER

required to play a senior part in mechanical design and contract control on chemical plant projects with experience in this field either with a plant manufacturer or user. The successful applicant will be in his early 30's and will have advanced rapidly in salary and status during the last few years.

Send full details of career, including salary history to The Staff Officer,

WHESSOE LIMITED,
Darlington A 979

ENGLISH ELECTRIC

require a

TECHNICAL SALES ENGINEER

There is a vacancy in our London office for a Technical Sales Representative to handle customers enquiries concerning Steam and Gas Turbines.

Applicants, who should be less than 35 years of age, must possess an engineering degree, or qualifications leading to Corporate Membership of the Institute of Mechanical Engineers; Membership of the Institute of Fuel would also be advantageous. Previous experience of Sales liaison, although not essential, is desirable.

Please write giving full details of qualifications and experience to **DEPT. C.P.S. MARCONI HOUSE, 336/337 STRAND, LONDON, W.C.2,** quoting reference EG597F. A 990

JOSEPH LUCAS (ELECTRICAL) LIMITED

There are vacancies for

DESIGNERS

and

DRAUGHTSMEN

for Lighting Department to work on mechanical design of a wide range of lamps for new car models. The work involves the application of pressure diecasting, pressing and plastic moulding techniques for large quantity production and some experience in one of these fields would be an advantage. Applicants should have Higher National Certificate, but consideration will be given to men with Ordinary National Certificate, and suitable experience. The posts are permanent and pensionable, and a good starting salary will be paid Five-day week.

Apply in writing, stating age, qualifications and experience to the Personnel Manager, JOSEPH LUCAS (ELECTRICAL) LIMITED, Great King Street, Birmingham, 19, quoting reference PM/D/360. B 13

SITE STAFF

SENIOR ENGINEERS, ENGINEERS, SURVEYORS, QUANTITY SURVEYORS, CLERK OF WORKS, INSPECTORS, BOTH CIVIL AND STRUCTURAL,

required for work outside the London area. Housing may be available in certain cases.

Please send full details of past experience to:—

PERSONNEL MANAGER,
W. S. ATKINS & PARTNERS,
158, VICTORIA STREET,
LONDON, S.W.1 A 977

LLOYD'S REGISTER OF SHIPPING

require

TWO ENGINEERS

initially for Research and Engineering Investigation, able to supervise laboratory tests and undertake stress calculations from strain gauge analyses. Applicants should possess a University Degree in Engineering, or equivalent qualifications, and have had some experience in industry. These posts offer ample scope for advancement in the Society's service.

Commencing salary in the range of £1100-£1500 per annum, depending on qualifications and experience.

Apply:—
SECRETARY, LLOYD'S REGISTER OF SHIPPING,
71 FENCHURCH STREET,
LONDON, E.C.3 A 991

PORTLAND BLUE CIRCLE CEMENT

DRAUGHTSMEN

required by

ASSOCIATED PORTLAND CEMENT MANUFACTURERS LTD:

to work in Area Engineer's Office, Stone Castle, Greenhithe, Kent, on drawings for the installations of new plant on a long term basis. Profit sharing and pension schemes in operation. Applicants, who should have some experience in bulk mechanical handling, should apply in writing stating training, qualifications, experience, age and salary required. A 926

THE DISTILLERS COMPANY LIMITED

The Company invites applications for the following appointments in the Chemical Division; attractive opportunities for further progress with the Division and the Company are attached to each post.

PROJECT ENGINEER

A Project Engineer is concerned with the design, installation and maintenance of carbon dioxide equipment supplied to customers, and with giving customers service on technical problems; he supervises the work of at least five Field Service Engineers.

This vacancy arises in the London headquarters of the Division. Candidates, aged between 22 and 30, should hold a degree or Higher National Certificate in mechanical engineering, but applicants with Ordinary National Certificate may be considered; they should also have practical engineering experience, and a knowledge of pressure vessels for chemical plant would be a further qualification. Some experience of electrical installations would be an advantage.

(Ref. 6/60)E

FIELD SERVICE ENGINEERS

A Field Service Engineer installs and services carbon dioxide equipment and pressure vessels supplied to customers. All practical work is carried out by the Field Service Engineer, who does not supervise the work of others. The location of this post is not yet clearly defined but will probably be in the north of England.

Candidates, aged not over 33, should have a good knowledge of pipework fitting and preferably some knowledge of refrigeration. A completed engineering apprenticeship would be an advantage and academic training up to Ordinary National Certificate would be an additional qualification. Candidates must hold a current valid driving licence. (Ref. 7/60)E

Write:—

STAFF MANAGER
THE DISTILLERS COMPANY LIMITED
21-22 BOLTON STREET
LONDON, W.1

Quote Reference Numbers above. B 24

A CONTRACTS ENGINEER

FOR PUMP DEPARTMENT

is required by

W. H. ALLEN SONS & CO., LTD.

QUEENS ENGINEERING WORKS BEDFORD.

The appointment is a responsible one, involving the handling of projects, tenders and contracts for complete pumping schemes. Applicants should have served an apprenticeship and reached at least Higher National Certificate standard, with experience in either drawing office, commercial department, plant-operation or manufacture.

Good staff Pension Scheme; assistance towards removal expenses.

Apply, stating age, experience, present salary, etc., to **THE PERSONNEL MANAGER** (quoring Ref. No. CA.202).

A 942

MECHANICAL ENGINEER

with senior status required for research and development work in Manchester. Honours degree, good knowledge of thermodynamics, metallurgy experience with design calculations of various kinds of thermal plant essential.—Apply

KENNEDY AND DONKIN,
12, CAXTON STREET,
LONDON, S.W.1
or
64, ROYAL EXCHANGE,
MANCHESTER.

A 929

Applications invited for the position of

"PERSONAL ASSISTANT to the GENERAL MANAGER"

Controls Division—Hopkinsons Limited, Huddersfield.

Applicants to be within the 30/40 year age group, preferably with an Engineering Degree, administrative ability, and a practical knowledge of the light electrical engineering field.

Applications to be addressed to the **General Manager.** A998

FULLY-QUALIFIED AND EXPERIENCED

WORKS ENGINEER

required by large, leading food company, with processes of a fully-automatic nature, near London.

Successful applicant will—

— control an engineering department responsible for: repair and maintenance of all mechanical and electrical equipment; installation of new equipment; building maintenance; power plant and machine shop.

— be able to demonstrate that he has successfully undertaken similar responsibilities in a similar type of Company.

— have proved himself in the administration of an engineering department, and the control of men.

— be a Chartered Engineer with appropriate qualifications which, ideally, will include a University degree in Engineering.

— be between 30 and 40 years of age.

Good commencing salary, progressive salary grade, excellent fringe benefits, and considerable scope, offered to first-class man of ability and potential in line with the requirements of an expanding organization.

Applications stating age, educational background, qualifications, experience, present position and salary, in strict confidence to BOX A 970, Offices of ENGINEERING.

ENGINEERS

ENGINEERS, CIVIL AND MECHANICAL—temporary—required by Iron Ore Mining Company for one tour of approximately 18 months duty in BRITISH WEST AFRICA. Civil Engineer to supervise foundation and steelwork contracts, and Mechanical Engineer to supervise installation of plant and machinery including electrics in an ore concentrating plant. Engineers with previous experience contract supervision essential. Salary £1900 per annum plus bonus plus for married man marriage allowance at the rate of £10 per month and children's allowance at the rate of £5 per month for each child under 18. Dependants Income Scheme and free Life Assurance. Return passage paid. Initial kit allowance. Free furnished accommodation and medical attention.—Write giving full details of experience stating age, married or single to SIERRA LEONE DEVELOPMENT CO., LTD., DEPT. M.P.6, CITY GATE HOUSE, FINSBURY SQUARE, LONDON, E.C.2. A 965

MECHANICAL ENGINEERS

MECHANICAL ENGINEERS. Due to expansion, a company specialising in centralised lubrication equipment require additional engineers to work in the company's London Office (Edmonton, N.18) or as Sheffield and Scottish area engineers respectively. Previous practical or sales experience of steelworks, heavy industry or lubrication an advantage.—Applications stating age, qualifications, experience, etc., will be treated in the strictest confidence, to be addressed to: MANAGING DIRECTOR, CENTRALUBE LTD., PARK ROYAL ROAD, LONDON, N.W.10. ELGar 3751. B 18

MECHANICAL

ENGINEERING DRAUGHTSMAN

MECHANICAL ENGINEERING DRAUGHTSMAN, preferably holding H.N.C. or equivalent, experienced in textile dyeing and finishing machinery.—Applications, stating age, experience, qualifications and salary required to THE CHIEF ENGINEER, THE BRADFORD DYERS' ASSOCIATION, LTD., 39, WELL STREET, BRADFORD, 1. B 19

PRODUCTION DEVELOPMENT

STAFF REQUIRED

for interesting new projects covering the following branches of Production Engineering:—

PLANNING AND TOOL DESIGN for machined parts.

PLANNING AND TOOL DESIGN for major assemblies and plate details.

PLANNING of Aircraft **ELECTRICAL INSTALLATIONS.**

Men with experience of one or more of the above are also required to work in conjunction with Aircraft Designers to advise on ways of achieving the best design of component for production.

DESIGN OF TOOLS and special machines for manufacture of components for **ATOMIC ENERGY PROJECTS.**

CUTTING TOOL DEVELOPMENT involving advanced techniques on light alloy and ultra high tensile steels, etc.

Applications from suitably experienced candidates should be sent to the PERSONNEL OFFICER, FAIREY AVIATION LIMITED, HAYES, MIDDLESEX. B 16

SENIOR DRAUGHTSMAN

required by an Engineering Company in Monmouthshire.

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TRANSLATORS (TECHNICAL), freelance, required by translation bureau. All languages, particularly Russian. Please state clearly from or into which language you translate, also preferred subjects, and fees.—BOX B 21, Offices of ENGINEERING.

ENGINEERS AND DRAUGHTSMEN

CONSULTING ENGINEERS urgently require additional staff in London and Darlington, engineers and draughtsmen for both reinforced concrete and steelwork.—Full particulars to F. R. BULLEN & PARTNERS, DACRE HOUSE, DEAN FARRAR STREET, S.W.1. A 981

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ENGINEER SURVEYOR required in South of England by leading Insurance Company for inspection of Boiler and Pressure Plant. Must hold 1st Class M.O.T. Certificate with Steam Endorsement or equivalent. Commencing salary £800 rising to £1100. Car Driver—not over 38 years.—Write Box EG 792, LPE, ROMANO HOUSE, 399/401, STRAND, LONDON, W.C.2. A 966

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Companies

Feast or Famine

Four-fifths of the orders obtained in the year reviewed in the annual report of the Walmsley (Bury) group, makers of pulp and paper making machinery, for reconstruction work on existing machines and ancillaries such as winders and supercalenders came from overseas. Finland, New Zealand and Newfoundland, were among the export markets in which orders were obtained by the group's representatives.

With a good order book over the next year and a considerable inflow of new and substantial inquiries, the chairman, Mr. Alan Green, M.P., reports that the intense competition that developed when paper mill expansion slowed down more than a year ago still has its "sharp edges." There is now a marked revival in paper mill equipment activity.

Among the developments from which the Walmsley group expects a promising immediate future are the manufacture of large high pressure cylinders, new screening equipment and the application of the Inverform principle.

Mr. Green pointed in his annual statement to the current dilemma of management: the need to be able to meet delivery dates and generally to equip against fierce world wide competition and the parallel need not to over commit resources since from time to time paper mill activity slackens. "Certain proposals" were at an advanced stage and are to be put before the shareholders in the near future. This is obviously of great significance since the group, like any other, has to grow in step with its customers' needs. In the paper machinery business, said the chairman, there was generally "either a feast or a famine of orders."

The Walmsley group in its overseas selling has crossed the borders of the European Common Market while at the same time enjoying considerable success in Scandinavia which causes the leaders of the concern to look forward to the European Free Trade Area with "interest." In November an order was obtained in Holland (a Common Market member) for a complete tissue factory.

Marconi's £600,000 Ghana Station

The four-transmitter short wave broadcasting station which Marconi's are to build for Ghana at Tema, just outside Accra, will be of world wide range.

Marconi's are to put up the buildings, in the form of a hollow square, and put in four 100 kW high frequency transmitters, the ancillary equipment and a 22 aerial system of HF dipole curtain arrays, some of whose masts will be 325 ft high.

The entire station contract went to Marconi's after lively competition from European and American electrical firms. All the major firms in the field put in quotations. In addition to the building and installation, Marconi's are to train personnel of the Ghana Broadcasting System in Ghana and at their Chelmsford works. The company will provide technical staff for maintenance and supervision for four years. Kenneth Scott Associates, of London and Accra, are the architects, and Widnell and Trollope are the quantity surveyors.

The building design had to take into account the possibility not only of earthquake shocks but the unavoidable intensity of the sun's heat and the salt-laden nature of the air. The four high frequency transmitters operate in the range 5·9 Mc/s to 26·1 Mc/s. In all stages air cooled valves are used, up to date circuit techniques and thoriated-tungsten main valves giving the high overall efficiency of 50 per cent.

The contract specified that the aerial system and its feeders should give an all-Africa coverage and world wide range when wanted. The aerial switching unit to be installed, with 92 aerial switches, is automatic and remote controlled.

Britain Leapfrogs the Continent

Britain was a late starter in prestressed concrete. Of recent years, however, such marked progress has been made that this country is on the brink of moving into a leading position. Mr. Marples, the Minister of Transport, has been to the Continent to see good road engineering, particularly good bridges, for himself. He may well see them, but it is also a fact that the drawings for some exceptionally fine bridges—better even than the Continent can show—are already complete on British drawing boards and only Mr. Marples' signal is awaited before construction begins.

One mark of Britain's progress in this field is the appointment of a Briton as chairman of the Freyssinet Organisation's international committee for the coordination of their group activities. He is Mr. J. V. Turner, chairman and managing director of P.S.C. Equipment Limited of Uxbridge, Middlesex. Mr. Turner recently undertook a world tour during which he established new production centres in India and Australia. His trip also took in Canada, the United States, Fiji, Singapore, Ceylon, Greece, France, Holland and Denmark.

In India there is much work to be done, especially road and bridge construction, and Mr. Turner told ENGINEERING that there are now a number of leading contractors there who are well able to put up major structures in prestressed concrete. However, the main object in locating a new equipment producing centre in India was to provide a base that could make and export to Hong Kong, Ceylon, Malaya and the Far East generally (except Pakistan, which would continue to be served from the UK), the Persian Gulf and both East and West Africa.

Commenting on his experiences, Mr. Turner remarked on the wide differences between the equipment sought by countries with high labour costs and those with low. In the US and Canada no expense was too high in order to obtain equipment that would save labour; elsewhere, such as much of the Far East, cheaper and simpler equipment was required. In all countries that he visited, Mr. Turner reports that he found at least a small nucleus of engineers who now had experience in prestressing techniques.

Brockhouse Development

The effect of a general improvement in the volume of orders over the last four months came too late to affect the balance sheet of the J. Brockhouse company but it enabled the chairman, Mr. John Brockhouse, to look forward with what he called "justified optimism."

The company has been developing light steel structures for a number of years and their ideas are now being increasingly taken up by the education authorities and by a number of government ministries.

Concentrating their hydraulic transmission developments in the industrial field, the company is now finding the use of its systems in fork lift trucks, earth moving equipment, locomotives and other applications more widely used. Supplying a growing export demand the company is selling in the promising West German market.

Changes on the railways led to the closing down of Lones, Vernon and Holden. This subsidiary's main occupation was geared to a type of buffer now changed by British Railways. After the closing down of the firm the mills for rolling buffer rods were scrapped and its other product, taper bars, transferred to the District Iron and Steel company. Lones, Vernon and Holden had been the first subsidiary acquired by the Brockhouse group.

Commenting that an improved trading result can be expected this year, Mr. Brockhouse emphasised that operating in an intensely competitive field they would be spending more over the next two years on replacements and plant improvements.

Canned Scotch?

Metal Box, who for several years have maintained a sales office in Glasgow, are to expand their manufacture of cans for processed food to Scotland.

Agreement has been reached to buy a 20 acre site south of Arbroath and building is expected to begin in the spring. Production is likely to start in the autumn. The company's own buildings and services department are designing the building for something over 40,000 sq. ft of floor space.

Since such a development is a direct encouragment to the subsequent growth of the canning industry in Scotland it may be one more help to the unemployment problem of there.

Machine Tool Fortunes

The drop in the trading profit of H. W. Kearns, machine tool makers, of £25,000 from the former year's figure of £277,752, reflects the deterioration in trading conditions referred to by the chairman, Sir Lionel Kearns, in his annual statement.

More optimistically he reports that orders were a little more plentiful in the last quarter and that at the end of September there was an order book of 11 months work.

The intense overseas activities of the company's executives was accompanied by taking part in the machine tool exhibition at Sydney, Australia, the national industrial production show, Toronto, Canada, and the Sixth European machine tool exhibition in Paris. At Toronto and Paris there was lively interest in the Kearns electronic control of horizontal boring machines.

The Next 10 Years for Decca

1959 closed the first decade of life for the Decca radar company; 1960 begins a decade in which its expansion is more likely to come from technical developments for existing users than from new installations.

Back in the founding year, 1949, most of such radar sets as there were in merchant ships were old war-time equipment. Rapid and world wide recognition was given to Decca's first marine radar set and over the next ten years the number of the world's ships fitted with radar rose to 18,000, almost half of them using Decca. No such increase in the number of ships to be fitted with radar can be looked for again.

Instead, marine radar will depend upon replacements and on equipment able to bring an increasing degree of safety to those moving on the oceans.

Expansion continues for radar in the observation of harbours and rivers and their mouths. Early this year the radar observation of the Thames, now carried on with one scanner from Gravesend, will be stepped up to an overall eight screen observation from the Pool down to well below Gravesend, all concentrated before the unceasing watch of the Thames Navigation Service officers at the Gravesend centre. Decca also holds the contracts to equip in a similar fashion the ports of Liverpool, Southampton, Hamburg and Khandla.

What defence contracts will mean to Decca or anyone else in the 1960's is an open question, but the contribution of Decca to the control systems for guided missiles gives the company a stake in the growing unmanned field of defence equipment.

Decca landing and navigational equipment in civil air transport application already has one of the post-war success stories behind it. Over the future of these applications, 1959 threw the shadow of American willingness to protect the home produced system regardless of technical superiority abroad, but Decca were able to make something of a retort with the interest shown by the Russians.

Air traffic control in and out of busier and busier airports is rapidly becoming a critical operation and if the well known difficulties were to lead to one or two disasters then the authorities would be compelled by public opinion to turn, perhaps to Decca with its Precision Surveillance radar, with a great deal more urgency.

For this application Decca, acting together with the Société Nouvelle d'Electronique, have solved the problems of operating on the 10 cm waveband in heavy rain.

For farmers, for the increasingly leisured public, as well as for the airlines and the fishing fleets, the 1960's are certain to bring increased demands on accurate short term weather predictions. Back in 1952 the company introduced the Decca storm warning radar and followed it by other devices able to locate rain.

Flexible Production Line

The Rootes light vans announced this week are in volume production at the Dunstable plant of Commer Cars Limited. Though laid out for full-scale production, flexibility of lay-out will allow output to be increased.

The layout, which covers an area of 70,000 sq. ft, is interesting because it has been designed to enable production to be increased with the minimum of alterations to the plant, while at the same time it is laid out in such a way that it is extremely compact. By reference to the flow diagram, it can be seen that this has been achieved by designing the assembly lines in a double S formation, and by including a mezzanine floor for finish painting. Other facets of the assembly line which are particularly worthy of note include the number of anti-corrosive and protective finishes applied to the body shell and the underseal spray which is claimed to be the first treatment of this type to be applied to a commercial vehicle during production.

The body, of unitary construction, is assembled from components supplied by the Pressed Steel Company. The first operation consists of assembling the front floor apertures, the front panel and rear posts to the main under frame. These are spot welded in a main assembly jig, after which the completed unit is lifted out on to high rails for the completion of spot welding. In this way, the time the body spends in the jig is cut down to a minimum. When the spot welding of these components has been completed, the assembly passes to a second assembly jig. At this point, the body sides and, according to the vehicle type, the third door, are assembled and tack spot welded. The assembly then passes on high rails to station number 4, where the spot welding is completed.

The body is next lifted by overhead monorail hoists to a mobile build trolley, after which the roof is assembled and tacked into position, before it moves to station 6 where the roof is completely seam welded to the panel sides. In addition, the front panel and the aperture "A" post are seam welded. At station 7, all finishes and cappings applicable to the complete range are added, while station 8 is used for the fitment of additional window finishes and fittings for the light bus. When this operation has been completed the body moves on to stations 9 and 10 where all the joints which cannot be spot welded are brazed or gas welded. At stations 11, 12 and 13, the points, doors, and mounting gear are fitted and set. This is followed at station 14 by the checking and setting of the window apertures to master template gauges. Next, the body is rubbed down and polished with pneumatic discing machines, before moving on to station 17.

Here, final inspection of the body in white takes place prior to primer painting. Although the body is finally inspected at this stage, patrol inspection takes place during all stages of body production.

After inspection, the body enters the primer paint shop where the first operation is to remove the protective coating of Ensis 256 from the body interior and exterior. This is done in a static 2-stage cleaning plant. These two stages comprise a one and a half minute hot alkaline spray which emulsifies the grease and a cold water rinse. From here, the degreased body is given a blow-off and it is sealed with Plasticol. The former treatment consists of blowing out all joints with compressed air, after which sealing compound is applied with a pressure gun, along the under frame to side joint. After sealing, the body is lifted by a hydraulic joist to a power-operated overhead monorail conveyor.

The conveyor takes the body through a dry-off oven heated to 300° F to ensure that all moisture is removed from the body sections and surfaces, after which all the outside surfaces are prepared for painting by the application of one coat of etching primer which is stoved on at a temperature of 300° F. To ensure adequate protection of the underside of the body, including the inside of the box-type sections, the conveyor dips so that the whole of the underside and floor are immersed in primer sealer.

After draining and de-nibbing, all outside surfaces are " tac-ragged " to ensure a clean and prepared surface for the application of the prime paint which is hot sprayed. This consists of a lap coat of minimum thickness 0·002 in inside and outside the body. After spraying, the paint is stoved on at a temperature of 300° F once more. The body is then inspected, rectified if necessary, and all joints dust sealed. The final process in the prime painting circuit is the application of underseal to the body underside. This is sprayed on and stoved at a temperature of 280° F.

For the next stage in the process, the body is removed from the overhead conveyor and once more dropped on to a trolley. At this point, it can either go direct to the trim track, or, if required, to the mezzanine for finished painting. The first process of finished painting is to prepare the body by rubbing down the primer coat and vac brushing the interior. The body is then inspected after which the surface is " tac-ragged " and spirit wiped to ensure a clean and dust-free basis for painting. In the first two booths, the inside and outside are given a coat of the specified colour which is stoved on at 180° F.

When the stoving has been completed, the body is inspected again and any blemishes are removed prior to the application of a third coat. This is also stoved at 180° F. Completion of finished painting is followed by the body being lowered down to the trim track, thus joining up once more with primer finished units.

On the trim line, the primed and finished bodies are fitted with windscreen glasses, hardware, electrical equipment and auxiliary fittings. At the end of this line, the bodies are hoisted by an overhead track to a high level station for the fitting of pipes, brake pedals, and accelerator controls. When this work has been completed, the body is finished and ready for the main assembly track. The track is made up from twin-strand, double tiered power conveyor fitted with fixtures at each station length for the location of major units prior to body mounting.

The operating sequence on the assembly track starts with the mounting of the independent front suspension to a location fixture on the track, after which the engine and gearbox assembly is lowered into position by an overhead crane. At the same time, the rear axle an spring assembly is lowered into a rear location fixture and the propeller shaft fitted. From here, the components enter station 2 where the gearbox, back axle, and engine units are filled with lubricating oil by a metering cabinet

Fig. 3 The body shell entering the anti-corrosion dip tank at Rootes commercial vehicle plant at Dunstable.

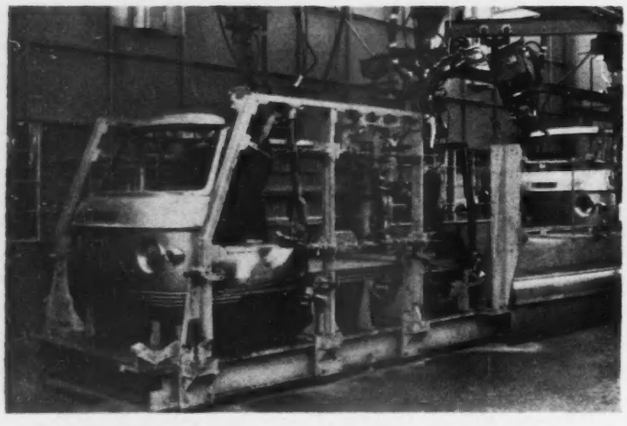


Fig. 1 The body of the Commer in the process of assembly.

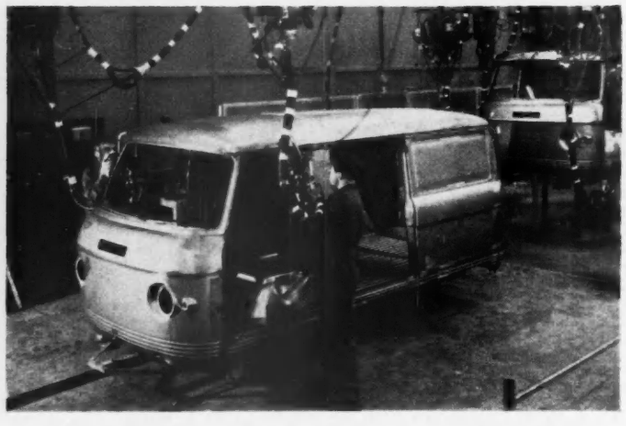
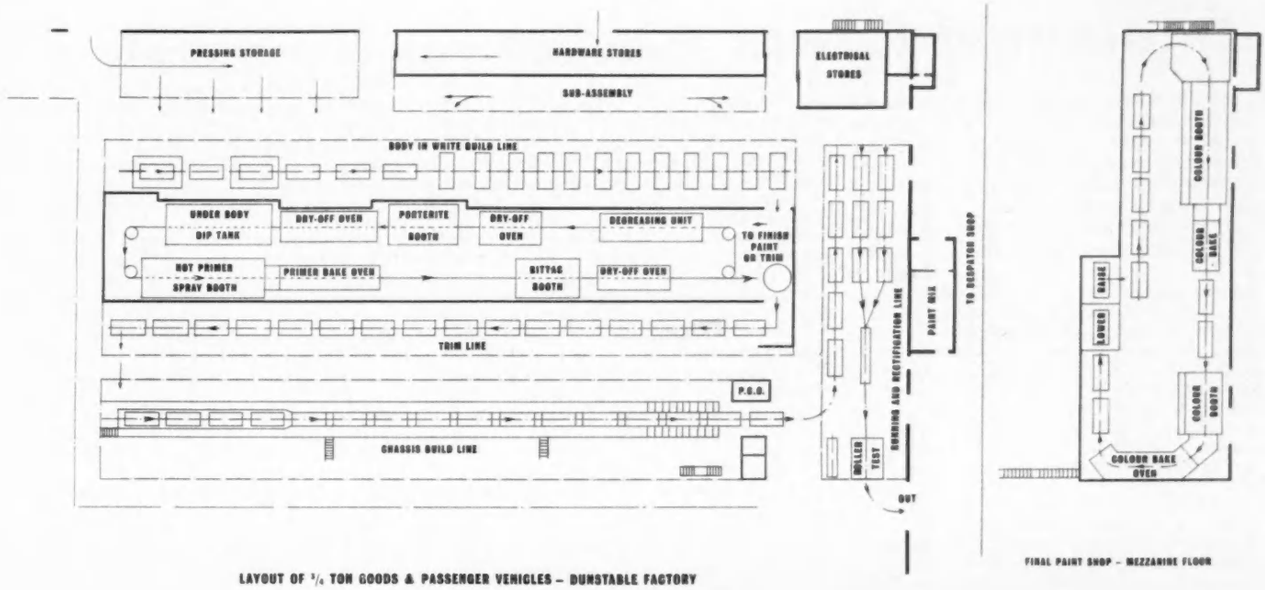


Fig. 2 The roo, of the vehicle being spot welded into position.



LAYOUT OF ¾ TON GOODS & PASSENGER VEHICLES – DUNSTABLE FACTORY

feeding through an overhead counterbalanced delivery line. Next the trimmed body is lowered and attached to the units.

From this point the vehicle is progressively assembled, and the components such as petrol tanks, radiators, and steering units are fitted. Before the wheels are attached, the brakes are bled by vacuum bleeding equipment. Then the wheels, complete with tyres, are fitted; the tyre pressures are checked and the vehicle is passed through the wheel alignment section. This accurately gauges the front wheels using a system of microswitches and setting lights.

When this is completed, the radiator is filled with water and the seats are fitted, after which the tank is filled with either petrol or diesel oil, according to specification. The vehicle is then ejected from the conveyor equipment and driven to the off-line stations. Here, final checks and adjustments are made, and the vehicle is cleaned, polished and identification badges are attached.

Finally, the completed vehicle is given a last inspection and check on a statistical test rig for road performance.

Fig. 4 (above) A flow-line diagram showing all stages of the assembly of the vehicle.

Fig. 5 (right) The Commer ¾-ton goods and passenger range on the final assembly line. The trim line is shown in the background.

Open Hearth Furnace Ousted by Electric Arc

Six electric arc furnaces are soon to replace all the open hearth steel melting furnaces at the works of Steel, Peech and Tozer, a branch of the United Steel Companies Limited. The new furnaces will each have a capacity of 100 tons, and when installed, they will form part of the largest electric steelmaking plant in the world with an annual output of 1,350,000 ingot tons of steel.

At present, the company have 21 open hearth furnaces: 14 of them in the Templeborough melting shop and seven at the Rotherham melting shop; producing between them about one million ingot tons of steel per year. The existing Templeborough melting shop is to be adapted to house the new furnaces, and the Rotherham shop is to be demolished entirely.

Initially, four electric furnaces of the swing-roof type will be installed, and it is planned to have the first of these in operation by January, 1963. In order to make a start on the plant, two open furnaces at the Templeborough shop will be closed in two years time, to be followed by others as the scheme progresses. Arrangements have been made to maintain the existing level of steel production during the changeover by fitting double oil burners to some of the furnaces and converting others to " all basic " refractory linings.

Taking the Work to the Men

An increasing demand from both home and export markets has led K and L Steelfounders and Engineers Limited, the makers of Jones mobile cranes, to expand their engineering division. They have taken out a long lease on one of the Board of Trade factories at Newburn-on-Tyne, some five miles from Newcastle-on-Tyne. This factory which is situated in the Newburn Trading Estate, has a floor area of 24,000 sq. ft, and is complete with all power, lighting, heating and other services.

Because of the great shortage of skilled engineering personnel in the Letchworth area where the company is at present situated, and in conformity with government policy, this expansion has been planned to take the work to where the men are available. It is expected that a start will be made there in the next few weeks with a dozen or so machines and a gradual build-up will continue through 1960.

Plastics Testing and Standardisation

The American Society for Testing Materials has published a booklet to tell those interested all about the International Symposium on plastics testing and standardisation which took place in Philadelphia in October 1958.

The symposium was concerned with four general topics, the first of which was " How National Standards are Achieved." Twelve nations were represented in this section. The second section was called " Engineering Properties of Plastics," and contained six papers. " Thermal Properties of Plastics " was the third part and had four papers. The last was " Molecular Characterisation " and it again had four papers.

The session on how national standards are achieved is reported to have accomplished the significant objective of presenting, following a standard outline, the 1958 national standardisation story for each of the twelve nations. This background should be most helpful in future work on plastics and, more broadly, in all international standardisation. The sessions on engineering properties and on the thermal properties of plastics dealt with techniques applicable to standardisation today and in the near future.

Unmanned Power Station

Public electricity supply must be able to meet unpredictable peak loads. Manned standby generating plant of the conventional type is uneconomic; a small, unmanned, remote-controlled unit can do the work at relatively low cost.

Sudden demands on a public electricity supply may be made for a variety of reasons; a common one being weather. Standby generating equipment should, ideally, be able to accept its full designed load in a very short time, and be capable of being started and run by remote control, so that it can be installed where it is wanted, with a minimum of duplicate supply lines. It should also be reliable, and of low capital cost.

Conventional generating equipment does not meet this specification in several respects, but a gas-turbine does; it has the additional advantages that it is of small size, can be installed on simple foundations, and needs no cooling water. The possibility of producing such a plant was the subject of a discussion between the South Western Electricity Board and Bristol Siddeley Engines Limited, Bristol. In April approval was received from the Minister of Power, and in the short space of eight months, a complete 3 MW standby plant, including a remote control system, has been designed, manufactured, installed and tested. It has now been formally commissioned.

The power unit is a Bristol Siddeley "Proteus" turbo-prop gas-turbine, a modified land version of that used in the Bristol Britannia aircraft, where it has already completed nearly a million engine hours in service. It is a simple free-turbine two-shaft unit, without a heat exchanger, the compressor and power turbines being mounted on concentric but mechanically independent shafts. This enables each system to run at its optimum speed under all conditions, and has three special advantages in the power generation application.

In the first place, the power required for starting is relatively low because only the compressor system is rotated by the starter; secondly, the alternator is coupled to a unit of low inertia, which facilitates automatic synchronisation; thirdly, the engine can meet an overload by putting out a higher torque at reduced speed without loss of power or risk of stalling. Power is taken off through an epicyclic reduction gear, the shaft h.p. being 4,250. Diesel oil to BS 2869, Class A, is the fuel. No space heating is required in the turbine house, and very little maintenance is necessary. After every 100 hours of running it is proposed that the filters should be inspected, the plant run, and the instrument readings logged. Initially, the engine should be inspected after 1,000 hours running; it is expected that this period will be increased later to 2,000 hours or more.

Power is generated at 11,000 V by an alternator coupled to the turbine. It is a unit rated at 3,200 kVA, and runs at 1,000 r.p.m. to produce 3 phase, 50 cycle current. Built by the Electric Construction Company Limited, Wolverhampton, the alternator is direct air cooled and has built-in heaters to prevent condensation.

The generator set is installed at Princetown, Devon, about 100 miles from the South Western Electricity Board's central control room at Bristol, from which it is controlled. This control room, which has only just been brought into use, has a 70 ft diagram on pale green vitrolite, which represents 2,000 miles of high-voltage mains and 2,800 substations on the local distribution system. It is manned continuously. "Datofonic" Mk II equipment, made by Sound Diffusion (Auto Thermatic) Limited, Portslade, Sussex, is installed for the remote control of the turbo generator.

This control system is a development of the manufacturers' Mk I equipment, which was designed to give central control room supervisory facilities over unattended substations. Hitherto, such facilities have only been available through the medium of privately rented GPO lines, but the Datofonic equipment uses an ordinary subscriber's line, and connection is made between the control room and the generating station for the cost of a trunk call. This use of subscribers' lines has been given limited approval by the GPO.

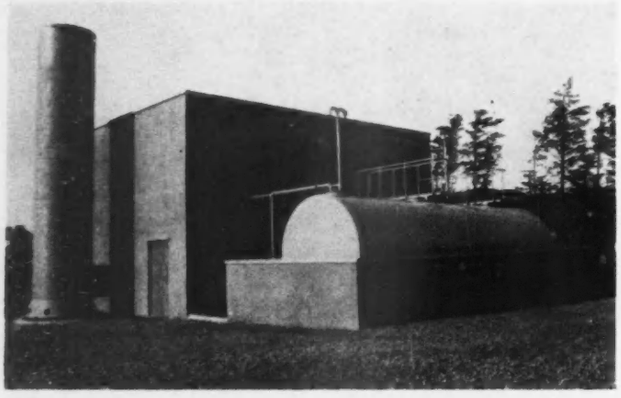
By dialling through to Princetown, the control engineer at Bristol can carry out a total of up to 40 control functions over the remote equipment; typical functions are "start," "stop" and "throttle" controls on the turbo alternator. These control facilities are supplemented by 22 pairs of indicator lamps, of which the turbo alternator uses 20. In addition, telemeter display facilities in the Bristol control room are available for such quantities as watts, amperes and volts. From this information the power factor of the distant alternator can be calculated by the control engineer. A very compact console houses the indication, control and telemetering equipment, and it is capable of simple extension to allow for the control of up to 24 additional substations.

After obtaining the required information and making any necessary control operations, the control engineer can instruct the remote equipment to disconnect itself from the telephone line. In the event of a change in the running conditions of the remote generating set, the station equipment automatically dials its own exchange line and verbally requests the exchange operator to be put through to Bristol control room. When the call is connected, the control engineer hears the station announce its identity by voice, and then all the control and telemetering facilities are at his disposal.

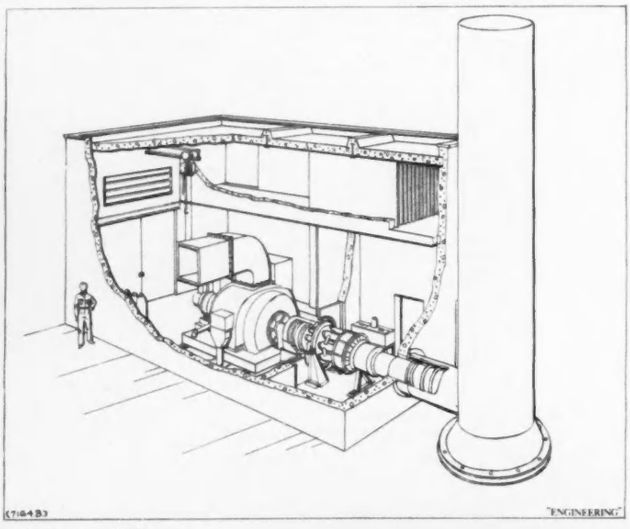
The unmanned power station is designed to meet emergencies. Within less than 2 minutes of pressing the starter button, the set is on full load. It can also be used to take part of the load of the normal generating equipment during a planned shut-down for overhaul or maintenance. Because it is small and requires only a simple, unobtrusive building to house it, the equipment is not only relatively cheap to install, it is also suitable for location in areas of high amenity value. Another set now under construction will, in fact, be installed at Lynton, North Devon, the well-known holiday area.

Noise has been dealt with by silencing equipment supplied by Burgess Products Company, Limited, Hinckley, Leicestershire.

Running costs per hour are relatively high, but this is more than offset by the low capital cost, the elimination of costly duplicate supply lines, and the manning of orthodox standby equipment.



(Above) An unobtrusive building, oil tank and exhaust stack are all that can be seen externally of the 3 MW unmanned power station.



(Right) This cut-away impression shows how the Bristol Siddeley turbine and Electric Construction alternator are housed.

The station is completely controlled from the Datofonic console at a Bristol control room, 100 miles away.

How Good Are Stone Preservatives?

It is apt to be overlooked, says the Building Research Station, Garston, Hertfordshire, that because building stone may have taken centuries to reach its present condition, the effects of a preservative can be overestimated. As the appearance of stone changes so slowly some methods of preservation have been used for 30 to 40 years before it was recognised that it had done no good. The only way at present of obtaining factual information is by proper trials in which treated and untreated surfaces are compared over a period. It is possible, however, to draw some useful conclusions from the experience which has already been accumulated and this has been done in Building Research Station digest No. 128, *Stone Preservatives*.

Paint, properly applied and maintained, affords a useful measure of protection, but it is often unacceptable for historic buildings because it masks the stone. Limewash, which has been used for some 35 years, has been criticised for the same reason, and it has not been proved to have any beneficial effect. Lime water is reported to have had appreciable strengthening effects on friable stone, but lime is so slightly soluble in water than 30 to 40 applications are needed. Silicon ester has no more than a temporary influence on the normal process of weathering, and scaling has followed its use on poor quality stone. Silicone water repellents, used either as a solution of a silicone in an organic solvent, or a solution of a metallic siliconate (usually sodium siliconate) in water, promise well in appropriate circumstances.

All these treatments are applied to the surface of the stone, but there is a further method available, which penetrates well below the surface. This is impregnation by wax which is fed to the warmed surface of the stone. It has been found to prevent the erosion of good quality limestones, but on stones of poor quality, scaling has occurred within five years. In addition, the surfaces have become dirty and unsightly.

A better method than surface application is to obtain complete impregnation by partial immersion, block by block, in a bath of molten paraffin wax. By this method decay, associated with the presence of calcium sulphate, was arrested some ten years ago in an exhibit on which treatment with a solution of wax had failed within two months.

Fractured Parts Repaired

Welding has done more than revolutionise the production side of engineering, it has made the maintenance engineer's life a lot easier, too. But welding repair work is usually very different from that done in the production shops, which is one reason why it sometimes fails. Repair welding is generally on a one-off basis, and it is often very urgent, as the breakdown of a single machine can stop a whole factory. Components for production by welding are designed to include the necessary machining allowances; a broken machine part often has machined surfaces or holes which must line up when the job is finished, another item to be planned into the welding repair. Again, a repair may involve welding one or more materials with which the factory using the machine is not familiar, or at least is not equipped to weld. Just how varied, and complicated at times welding repair work can be is shown by a booklet issued by Barimar Limited, 22 Peterborough Road, Fulham, London, SW6.

Cast iron figures largely in repair work, for the part of an overloaded press, shear or similar metal working machine which fails is often the housing or frame, which is usually of cast iron. This material is sometimes considered to be difficult to weld satisfactorily, particularly where the part is highly stressed, and so it is, if the right equipment and techniques are not used. How the repair is made has to be decided on the merits of the particular job. A straight break through a housing or frame may be repaired by a relatively simple welding operation, though it has to be of a type which prevents distortion if the finished repair is to reassemble without rectification. Alternatively, welding of a broken casting may be modified to enable the component to be built up at the point of breakage, if this is considered desirable. Sometimes it may be necessary to cut out part of a casting which has become damaged, porous or corroded.

Steel castings and forgings again call for specialised treatment; engine and compressor crankshafts are particular examples in the latter category. They often twist in one part as well as breaking in another, and in such cases not only must the weld be carried out to bring the throws into alignment, but the twist must be removed as well—all with due consideration for the metallurgical properties of the material.

Iron and steel are not, of course, the only materials which can be welded today, and welding repair work is carried out regularly on aluminium alloys, copper, and other non-ferrous metals.

How to Drive an Excavator

Excavators today, like motor cars, are easy to drive, but they will not drive themselves Drive them properly and they will give good service; drive them badly and they will not only fail to maintain their proper output, they will break down more frequently and may well do damage to property and injury to persons All this, of course, is very obvious to the engineer who is responsible for running and maintaining excavators, but it is not necessarily so to the driver. It is the man in the cab who can make or mar the performance of the machine. Detailed instruction books are supplied with excavators, and the driver should be encouraged to read them, although much of the contents may really be of more interest to the maintenance man. Something more than a technical instruction book would be of value to the main the cab, and it was this fact which NCK Rapier Sales Company Limited, 32 Victoria Street, London, SW1, had in mind when they produced their pocket-sized illustrated booklet *How to be a Star Driver*.

Because an excavator is designed to do heavy work it is a powerful machine, and it can just as easily take the corner off a building or smash the cab of a lorry it is loading as it can lift and place the load safely where it is wanted.

An excavator has to work in soft or broken ground, and parking for the night or week-end is not simply a matter of leaving it where it stops work, locking up and going home. Parking has to be done safely on a piece of ground which will not subside slowly and deposit the machine in the excavation. Fording streams or pools is another operation commonly demanded of excavators, and here again the driver can run into trouble if he does not feel his way. Large boulders or deep holes hidden by muddy water can be detected by feeling the way first with the excavator bucket.

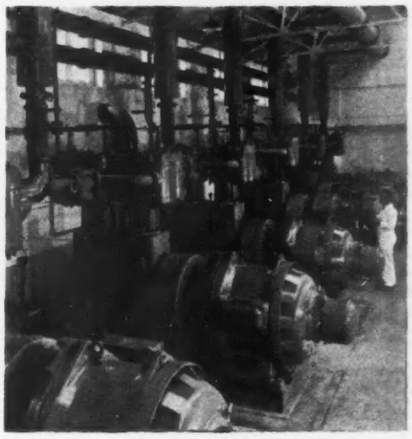
Maintenance does not normally concern the driver, except insofar as he reports the necessity for action, but he is well advised to make at least a quick check of the machine after repairs. A guard might have been left off, and while it is clearly the responsibility of the maintenance man to put it back, it is small consolation to an injured driver to know that it was all somebody else's fault.

Smooth operation, safety of machine, driver and other personnel and property on the site, maximum output—all these are really a matter of common sense and the observance of a few simple rules. Jerky, flashy, operation may look impressive, but it is hard on the machine—and the driver—and it may be dangerous.

Sterile Compressed Air

In the manufacture of antibiotics and other chemical substances, Pfizer Limited, Sandwich, Kent, use a process of aerobic fermentation, in which micro-organisms are grown in a "broth." To enable the fermentation to proceed, compressed air has to be passed through the broth, and since the air could act as a carrier for contaminating micro-organisms, it must be sterilised before use.

To supply the air, Pfizer Limited have installed two-cylinder, single-stage, double-acting compressors of the dry-cylinder carbon-ring type, made by Broom and Wade Limited, High Wycombe. Large quantities of oil-free air are supplied by these compressors. During the adiabatic compression of the air, cylinder heat is produced which partly sterilises the air, and before it goes to the fermentation tanks, it is passed through glass wool filters, which provide the final sterilisation stage. Two further Broomwade compressors provide compressed air for general factory service. (See picture).



On the Shelf

By Frank H. Smith

It has happened at last. A breath of sanity. In a report in *The Times* recently on a conference of the universities of the United Kingdom there is this: "What a later speaker described as 'a horror picture of the monster from the cataloguing room' was painted by Professor J. M. R. Cormack, Professor of Classics, University of Reading. 'As many people as possible should have access to as many books as possible with as little as possible difficulty' was Professor Cormack's motto. He referred to an 'iron curtain' built up between the reader and his books, and to classification as 'an esoteric cult of the professional in danger of becoming not a means to an end but an end in itself'." I think I have said something in the past about the witchdoctory of the classifying fetish worshippers and I should like to shake Prof. Cormack by the hand any time he is this way. (This way being in the Mayfair area.)

The Institute of Directors' annual conference usually hits the headlines (it can afford to) each year and the outstanding speeches of 1959 have been recorded for posterity and anybody else who cares to pay the price. Sound News Productions of 10 Clifford Street, New Bond Street, W1, offer you Sir Alexander Fleck for 92*s* 6*d*, Mr. Harry Oppenheimer at the same price, Lord Mountbatten for 97*s* 6*d* and Lord Chandos plus General Spears's introduction at 102*s* 6*d*. It is no good getting the discs for the pleasure of breaking them because they are unbreakable, and if you've an old-fashioned phonograph they are no good as they are 33⅓ r.p.m.

Pergamon have sent along the three first numbers of *human factors*, the Journal of the Human Factors Society of America. As far as I can see it is chiefly about the amount of energy expended in doing things. For instance, "Forces that may be exerted by man in the operation of aircraft door handles" and "The use of gliding cyclograms in biomechanical analysis of movement." It sounds as though these are the sort of people who prove that my banging away at this typewriter is equivalent to the shovel work of a navvy for half a week. Excluding the additional brain-fag required by the navvy.

If I appear to flog the *Applied Mechanics Review* it is not because I have shares in it but simply because I think you may like to know of their "review of the state of the art" articles. November, for instance, dealt with "Random Vibration," by the Prof. of Mech. Eng. at MIT. There are 86 refs.

The librarian of the Institution of Engineers and Shipbuilders in Scotland should have a pretty shrewd idea of what his loan library costs will be by now. I see from their report of the Council that the current year's loans were, at 1,369, an increase of two over the previous year.

The DSIR have issued *Automatic Control in Soviet Industry*, a report of a visit to the Soviet Union in May 1959. It looks as though it might be free to anybody interested, and you can but try the Hon. Secretary, Group B, British Conference on Automation and Computation, c/o Institution of Electrical Engineers, Savoy Place, London, WC2. Extracts from the report were published in this journal recently (ENGNG., 11 Dec. '59, p. 626).

The *United Nations Review* for November had "The United Nations Library—Gift of the Ford Foundation." If you can turn $6,200,000 into sterling you will know what they had to play with. I hope there's a coffee percolator tucked away somewhere just in case the assistants can get five minutes away from 400,000 books, 2 million cards and the 100 people using the reference section.

Quiet Flows the Office

Organisation and Methods. Edited by G. E. MILWARD. *Macmillan.* (63*s*)

During recent years the simplification and improvement of office methods and procedures has attracted considerable interest, notably in the public services and in business undertakings employing large numbers of clerical staff. In 1957 a common interest in the problems of securing greater efficiency in the office led a number of these companies to cooperate in setting up the Organisation and Methods Training Council to facilitate exchange of experience and information. This book is based on the practical experience of nine large firms participating in the council. It is edited by Mr. G. E. Milward, formerly of the Organisation and Training Division at the Treasury.

All modern business of every phase calls for activities of a clerical nature. These fall into two broad groups—activities of recording and activities of communicating. Certain of these activities in big undertakings employ large numbers of staff and are carried out in segregated rooms or departments which are described as offices. But similar activities arise in connection with every function of the business. We find check-writers and planning clerks and wages clerks and so on in the works. In the stores there is further clerical work to be done. And as every person who has analysed the procedures in a complex business knows very well, the total volume of clerical work called for from employees of all kinds may bear very little relation to the number of persons specifically designated "clerks" and sitting in an "office." Moreover, where there is a genuine attempt to reduce the total volume of clerical work it is usually impossible to do so if investigation is limited to the procedures which take place in the office. Research has always to be pushed back to the point of origin either of a record or of a communication.

Our knowledge of how to manage such clerical activities has increased enormously in the last quarter of a century. This is in some part due to mechanisation. There has been a very rapid development of inventions and devices designed to perform routine clerical tasks mechanically. This, however, is only part of the story. More important has been the gradual realisation that the principles covering the effective and economical performance of clerical work are the same as the principles covering the effective and economical performance of any other kind of work. Recording and communicating are quite as much production jobs as making bolts or battleships. That the product happens to be letters or invoices or statistics in no way alters the underlying fact that high and accurate productivity can be secured, and can only be secured by the application of the same principles of management as those developed in connection with modern factory work.

It is now pretty generally recognised that the modern production manager must be a specialist. He has to understand not only the technical nature of the goods he is manufacturing and of the processes which he is controlling but also costing, planning, personnel control, layout, and so on. In the same way, though this is less generally recognised, if we are to get the best results from clerical activities there must be within the organisation persons specialising in the control of clerical production. This is merely an extension to clerical work of the principle of specialisation which is already accepted in relation to other business activities.

But if the undertaking is to secure the fullest possible advantage from the work of such specialists they must have authority to investigate and to suggest changes wherever clerical activities arise. Only in this way can they push their thinking about procedures back to the point of origin in the way which is essential if they are to secure maximum effect.

It is in order to meet this need that an increasing number of enlightened undertakings have set up organisation and methods sections charged with responsibility for improving their standard of office management. However, there is still considerable room for the extension of this kind of specialist inspection and help, not only in the big and prosperous concern, but also in the smaller one. For if the principle of specialisation is right, it is right everywhere. The firm which ensures efficient clerical management gains not only in terms of money, but, what is even more important, in terms of human values.

This book is designed to help all those who are concerned with this important task. It is lucidly written and comprehensive, covering not only the techniques involved in securing increased efficiency in the office but also management of organisation and methods work and the difficult problems in human relations which inevitably arise when existing methods and procedures are being investigated. It fills a significant gap in the literature of this subject and it can be thoroughly recommended.

L. F. URWICK

Ubiquitous Profession

Chemical Engineering Practice. Edited by HERBERT W. CREMER and TREFOR DAVIES. Volumes 5 and 6: Fluid Systems. *Academic Press, New York; and Butterworths Scientific Publications, London.* (*Volume* 5: 100*s*; *Volume* 6: 95*s*)

Most professional engineers over the age of forty would confess that at some time or other they have asked the question, "What *does* a chemical engineer do?" During the last few years this ubiquitous profession has intruded into so many activities that one may be tempted to ask instead, "What is it that a chemical engineer does *not* do?" If the series of books *Chemical Engineering Practice* is intended to give the definitive answer to the first question, then it would appear that above all things chemical engineers are concerned with transfer processes of all kinds; the transfer of matter, of heat and of momentum. Inevitably chemical engineers have acquired considerable expertise in the properties and behaviour of "fluid systems" and it is this topic which is the subject of Volumes 5 and 6 of this series.

It should perhaps be mentioned that Volume 4 contained a theoretical dissertation on fluid mechanics which would be quite appropriate to a university text-book for advanced students. Volume 5 follows logically with sections on the practical design, selection and operation of pumps, fans, blowers and compressors, with a good deal of practical detail which is certainly not usually found in university texts. Much of the material in these sections, which comprise 150 pages, has been contributed by engineers from the Billingham Division of ICI Limited. While there is some concession to the academics in, for example, a discussion of the simple thermodynamics of compression, the real value lies in the presentation of a great deal of practical information. The Billingham contribution is continued by a section on pipe systems, in which a commendably short space is given to pressure drop and the conventional topics which are to be found in every fluid mechanics book. Instead, once again most of the section consists of a description of practical points such as layout, supports, corrosion protection, heating and insulation, and a complete bibliography of British Standards specifications.

To complete the first half of Volume 5 there is a section on the "production of vacuum" which is best described as a discussion of the fluid mechanics of pumps and pipe systems for low-pressure gases, and a section on the design of high-pressure vessels. The latter is obviously academic in origin and most engineers will be content to turn over the pages of mathematics to search for the practical information, and there is a fair amount of this.

If the first half of Volume 5 is of interest and value equally to mechanical, civil and chemical engineers, the second half is specifically for chemical engineers. Here are discussed the underlying theory and methods of design of the processes and equipment for liquid-liquid solvent extraction and for distillation. The authors are all associated with the Department of Chemical Engineering at Birmingham University and most of them are well known for their original contributions to the subjects. As might be expected, this part of the book resembles most a university textbook and indeed can be recommended as a textbook for all but the most advanced studies. The practical side has, however, not been disregarded. This is specially true in the chapter on distillation equipment, in which most of the new and fashionable distillation plants are described and their performance discussed.

Volume 6 continues in the same way, with an article on the subject of gas absorption. Here again there is the inevitable textbook treatment of the gas-liquid equilibrium and of the design of process plant. There is much useful practical data which have been obtained (and previously published) on the performance of commercial tower packings, and a few worked examples of design calculations. The next chapter, on "evaporation practice," is somewhat different in that there is a greater emphasis on the "practice." There are good illustrations of many kinds of commercial evaporators and of the way in which the flow in the plants is arranged. This kind of treatment is most valuable to the hard-pressed university lecturer who can refer his students to this chapter and so avoid spending valuable lecture time on descriptive topics.

The rest of Volume 6 consists partly of what the chemical engineers used to describe as "unit operations" and partly of associated processes, with one chapter which has the apparently anomalous title of "colloids." Considering the topics in the order in which they are presented, the first of them, "fluidisation," consists of a description of the dynamics of fluidised beds, including considerations of mixing and heat and mass transfer. The treatment is academic, with a comprehensive survey of the literature up to 1956. The more practical aspects of fluidisation as applied to chemical reactors are discussed by another author, with the inevitable emphasis on fluidised-bed cracking processes. Next in order is a chapter on the liquefaction and separation of gases, which in 52 pages contrives to be surprisingly comprehensive. Then "adsorption," which can best be described as a useful introduction to the subject, and after that "refrigeration practice." This section mainly comprises practical information and a description of various applications of commercial refrigeration processes. Professor Donald contributes a chapter on "leaching," a subject he has made all his own, and University College, London, is further represented by chapters on "crystallisation," "colloids" and "filtration." These chapters are typical, in their balance of theory and practice, of what is found in almost any traditional book on chemical engineering processes. Once again there is reinforcement of the practical side by a most valuable chapter on the selection and operation of filters. This pattern of separation processes is continued with "centrifuging" with many illustrations supplied by equipment manufacturers, and last of all a short chapter on "sublimation and vacuum freeze drying."

With the publication of Volume 6, the series *Chemical Engineering Practice* is halfway to completion. The question may well be asked as to how far the series is fulfilling its purpose, or, since its purpose was never explicitly defined, how far it is satisfying a need. The mixture of university textbook, review articles and down-to-earth engineering practice is curiously successful. Perhaps the general editor, H. W. Cremer, was right in the words he used in his preface to Volume 1, "a definite coherent heterogeneity."

CHEMIC

Interpreting By Numbers

Stastical Quality Control. By DOUGLAS H. W. ALLAN. *Reinhold Publishing Corporation, New York;* and *Chapman and Hall, London.* (28*s*)

Statistics—An Introduction. By D. A. S. FRASER. *John Wiley, New York;* and *Chapman and Hall, London.* (54*s*)

Statistical Estimates and Transformed Beta-Variables. By GUNNAR BLOM. *Almqvist and Wiksell, Gebers förlag AB, Stockholm, Sweden; John Wiley, New York;* and *Chapman and Hall, London.* (40*s*)

It is likely that the best car drivers are those who know something about the things that go on inside the engine. But so long as the car is driven carefully on roads designed for regular usage it is not vital to have a knowledge of the principles of motor engineering in order to be able to make good use of the vehicle. If, however, it is desired to design a car, to use it for unusual types of work or to modify an existing vehicle for special trials in rough country or the like, then a good knowledge of motor engineering is essential. This type of reasoning may, by analogy, be applied to statistics.

It is not necessary to know the details of the mathematical basis for statistical methods in order to be able to make good use of them in well tried areas of application. But if it is desired to use statistics in an area which has not been thoroughly explored, or if it is necessary to modify established methods for purposes to which they have not been regularly applied, or if there is reason to make special test statistics (relating the design of the tool to the special task required) then it is essential to know and to be able to handle the fundamental mathematics which are the basis of statistical analysis.

Three recent statistical books cover the range from applications in a very well tried field, to some fundamental work which should be of value to those concerned with producing new and better tools of statistical analysis.

The first, *Statistical Quality Control—An Introduction for Management*, could (perhaps unkindly) be compared with a simple driving manual for lady drivers who did not expect to have to get their hands dirty or their brain befuddled by the details of the inner workings of the machinery! It contains no mathematics, unless the equation for a straight line may be be termed mathematics. But this does not mean that it is not a useful book for those who do not want to drive themselves but to have a better appreciation of what a good chauffeur could and should do; what, in fact, goes on in a statistical quality-control routine.

The book is in good plain English. Indeed, it is necessary for the reader to remind himself from time to time that it is by a foreign author and the language is at times foreign. The author is American, and although the words are English they refer occasionally to production practices and statistical methods which in the United States mean slightly different things. Translation into English from American is something which the average television addict can now manage in his subconscious, but this facility applies only to strictly non-technical language.

It is customary in this country to regard quality control as much more restricted in its coverage than is the case in the USA. Here it is almost exclusively seen as a function of inspection, whereas in America the quality-control manager has extended his sphere to include "operations research" and the more general applications of statistical techniques to almost all aspects of the production processes, even at times to the fringe of that territory which is regarded as the domain of the salesman. This book, apart from a few notes on operational research applications, is content to confine discussion of statistical methods to the restricted British meaning of the term "quality control." It also indicates that such techniques as the analysis of variance and covariance exist, and gives some idea of the role these might play in production problems. There is a bibliography.

It is the bibliography which most brings home to the reader the fact that this is a foreign book. Only one true British book is quoted, Moroney's Penguin *Facts from Figures*. Brownlee's *Industrial Experimentation* is, perhaps naturally, not mentioned as being originally published by HM Stationery Office. And Brownlee was himself attracted to the United States some years ago.

There are British books which cover the subject treated in this book equally as well, but some of them are more likely to be found in libraries indexed under "operational research" than under "quality control." There is nothing new in this book, but it marshals a number of unusually useful pieces of information into a handy format. The actual techniques of quality control are, for those who wish to apply them, better explained elsewhere. The explanation given here is not designed for them, it is to give those at management level some information on this matter, and rightly it concentrates upon the relationship between the management function for this work and the technical side. Indeed, the most useful contribution of this book is in a very well thought out summary of the fields of responsibility which might be found in the terms of reference of a quality-control manager. These include problems relating to new designs; quality of incoming materials, process and product control and special process studies. Management could use these sections of the book as a check list to see how well their quality control systems were functioning.

The slight treatment of the technical aspects of quality control covers measures of central tendency, variance, sampling, types of distributions (illustrative and possibly stimulating, but it might shock "experts"), acceptance sampling by attributes and variables.

Apart from the quality control managers' draft charter or "management check list," there is no reason for any person familiar with BS600R to read this book.

Statistics, an Introduction, is an entirely different book. Here is a manual covering the fundamental mathematical principles which are the very foundation of statistical methods. A knowledge of the calculus such as might be gained in a full year's course is required, and if this course did not cover determinants and matrices, it might be necessary for some additional homework to be done in this area.

To say that this is a good introduction to mathematical statistics is not enough; there are so many good introductory texts written for so many different backgrounds of potential reader. Every such book includes some things omitted

Continued on next page

from others. It is to be regretted that so much time is spent in writing just another introduction to this subject.

It would be so much better if people who can write about statistics as well and as clearly as Professor Fraser would give us instead books dealing with special aspects of statistical work. There are many areas of statistical methodology which are generally recognised as specific areas, and yet in order to obtain the required information on these it is often necessary to search through a large number of books and papers picking up pieces here and there.

This book deals first with elementary probability, using classical sampling models as the main examples. Discrete and continuous probability distributions are considered. Sampling from probability distributions and from finite populations is dealt with and the analysis of variance is introduced through the latter. Estimation, hypothesis testing, confidence methods, regression analysis, factorial designs and sampling inspection and sequential analysis are given a chapter each. References, bibliographical material, examples and tables are included. There is a good index.

Statistical Estimates and Transformed Beta-Variables continues the current trend in statistical development towards problems in order statistics and estimation. It will be of considerable interest to mathematical statisticians who are concerned with developing the fields of statistical estimation to deal with more varied types of distributions more efficiently. The work reported in this book springs from the recent interest in "plotting" problems and the general problems of estimating parameters by means of linear functions of order statistics. Jung's method for replacing the laborious procedure for finding linear estimates with minimum variance by an approximation method is developed into a theory of nearly best linear estimates.

Three types of distributions are classified according to the asymptotic behaviour of information (I) as originated by Fisher—this concerns the behaviour of the underlying cumulative distribution function:

$$I = nE\left(\frac{\delta \log f}{\delta \alpha}\right)^2 = n\int_{-\infty}^{+\infty}\left(\frac{\delta \log f}{\delta \alpha}\right)^2 f(z\,;\,\alpha)\,dz$$

where n is a random sample for the population with a frequency function $f(z\,;\,\alpha)$.

It has previously been held that information (I) is additive such that the amounts of information available in each of two independent samples, added together, when the samples are combined into one single sample. This is shown not to be generally true and to depend upon the types of distributions as they are classified in this work. For certain distributions it seems that when two samples are of equal size and large and are added together into one sample, the total information becomes four times greater than the information inherent in each subsample.

The majority of engineers and even statisticians in industry will almost certainly have to wait until this theory has been spelt out by others into practical applications.

L. T. WILKINS

Metal Lattice

Elements of Physical Metallurgy. By ALBERT C. GUY. Second edition. *Addison-Wesley Publishing Company.* (60*s*)

The inclusion of dislocation theory in the second edition of an earlier textbook is a good example of how a major contribution to metallurgical knowledge within the last few years has now been incorporated in the basic information taught to engineering students. The subject is covered simply and effectively in the present work, which provides an introductory course in physical metallurgy for engineering and science students. The book is also intended as the first introduction to physical metallurgy for metallurgy students. This second edition differs from the first mainly in additions and revisions to bring subject matter up to date—a process which is essential in view of the rapid development in this branch of science.

It is indicated that while it is desirable to have a general science background, no previous metallurgical knowledge is necessary to make effective use of the book. Consequently, an introductory section of 42 pages attempts to acquaint the student with metallurgy. The only major criticism is directed at this introduction. It is felt that it has little relevance to the fundamentals of physical metallurgy and is too superficial to be of use as an introduction to metallurgy. There would be no loss if this introduction were omitted.

Following the introduction, however, the subject is covered systematically and thoroughly. Starting from atomic structure, metals are then discussed in terms of crystal structure and phase diagrams. This part of the book which occupies 210 pages is the real heart of physical metallurgy and is clearly explained and well illustrated. But it is only half of the book and in the second half it is not so easy to see the logical sequence of subjects considered, which are elasticity and plasticity of metals, corrosion and oxidation, diffusion, crystallisation and grain growth, age hardening and heat treatment of steel. Since these occupy another 250 pages it can be seen that they are tackled thoroughly. On the other hand, there are frequent descriptions of testing methods and equipment which again are not fundamentals of physical metallurgy, nor are they complete enough as separate descriptions of these aspects of metallurgy.

A metallurgical student will need several textbooks even to cover his introduction to metallurgy. These will at least cover process metallurgy, physical metallurgy and the properties of engineering alloys. Unfortunately, he finds that books on these subjects overlap considerably and this one is no exception. It describes the fundamentals of physical metallurgy adequately but frequently strays on to other subjects. This makes the book longer and consequently more expensive than it need be.

K. J. IRVINE

The Reviewers

Lieutenant Colonel Lyndall Fownes Urwick, O.B.E., M.C., F.I.I.A., Companion I.Mech.E., M.I.Prod.E., was until 1951 a professional management consultant. Since then he has continued as chairman of the London consulting firm, Urwick, Orr and Partners Limited, which he founded in 1934 He has been vice-chairman of the British Institute of Management and was chairman of the Urwick Committee which in 1947 established a syllabus for the teaching of management in Britain.

Chemic occupies the chair of chemical engineering at a leading provincial university. He is an M.Sc., an M.A., and a member of the Institution of Chemical Engineers.

Mr. Leslie T. Wilkins is statistician in the Home Office research unit. He is an incorporated statistician (FIS), a fellow of the Statistical Society, and a Francis Wood prize winner.

Dr. K. J. Irvine is deputy research manager in the research and development department of the United Steel Companies Limited. He holds a B.Sc. and a Ph.D., having specialised in metallurgy.

New Books

Pneumatics for Industry. By F. X. KAY. *The Machinery Publishing Company Limited.* (18*s* 6*d*)

In this book, one of *Machinery*'s standard reference series, the author distinguishes between "industrial" and "instrument" pneumatics, and deals with the former. Pneumatic equipment for industrial use must, in addition to being accurate, be robust and capable of long-term hard work. A large choice of equipment is now available, and pneumatic operation is extremely versatile. Starting with first principles —simple cylinders and control gear—the author shows how pneumatic circuits can be built up for an almost endless variety of industrial applications, and includes information on hydro-pneumatics, which are increasingly important in some machining operations. Practical circuits, taken from actual machines, are used to illustrate the scope of the many circuits described.

Non-Destructive Testing. By J. F. HINSLEY. *MacDonald and Evans.* (75*s*)

Non-destructive testing is not new, but its scope has widened enormously in recent years. Stimulated by the demands of the war and by subsequent technical developments, inspection standards have become far more onerous, and new techniques have been added to, or have replaced the older ones. This book reviews the whole subject, from definitions to safety precautions needed when radio-active materials are used. Generously illustrated with both line and half-tone blocks, and provided with a good index, the book will serve both as a text-book and a ready-reference manual.

The Iron and Steel Industry in Europe: A Study by the Iron and Steel Committee, June, 1959. *The Organisation for European Economic Co-operation, 2 Rue André-Pascal, Paris 16e; HMSO, London.* (14*s*)

Covering the period from the second half of 1957 to the first half of 1958, this volume is one of a series dealing with trends in particular economic sectors. It shows that the less favourable order position in 1958 did not lead the industry to reconsider its expansion plans. Attention is drawn to the undesirable, though understandable, practice among consumers of trying to add to their stocks when production is unable to meet the demand, and reducing stocks when production is adequate.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Polythene Film. BX PLASTICS LTD., Higham Station Avenue, London, E4. Polythene film is an inexpensive material with many packaging and protective uses. Brief mention of use as damp-courses and as a slip membrane. Booklet.

Copper and Copper Alloys. IMPERIAL CHEMICAL INDUSTRIES LTD., Millbank, London, SW1. A comprehensive publication covering all this company's main copper and brass sheet and strip production. 52 pages of good, solid technical information. Booklet.

Forging Alloys. JESSOP-SAVILLE LTD., Brightside Works, Sheffield. Forging alloys for high temperature application described generally and in detail in two sets of information sheets. Loose leaf catalogue.

Cold Caulking. PHILPLUG PRODUCTS LTD., Wembley, Middlesex. Properties and uses of cold caulking compounds types PC3 and PC4. Leaflet.

Prime Movers

Diesel Engines for Oilfields. ENGLISH ELECTRIC CO. LTD., RUGBY. Diesel and dual fuel engines as used both in prospecting for oil and in permanent installations, for power generation and for pumping. Details of package units. Leaflet.

Marine Auxiliary Steam Turbo-Generators. ENGLISH ELECTRIC CO. LTD., RUGBY. Condensing steam turbo-generators from 350 to 1,500 kW, specially designed for marine auxiliary duty. Brochure.

Back-Pressure Steam Turbo-Generators. ENGLISH ELECTRIC CO. LTD., WHETSTONE, NEAR LEICESTER. Back-pressure steam turbines geared to alternators, with outputs from 400 to 5,000 kW. Brochure.

Hydraulic Drive for Diesel Locomotives

The transmission consists basically of two Vulcan-Sinclair fluid couplings and a two-speed gearbox, built into a self-contained unit to the layout shown in Fig. 1, 2 and 4.

The transmission was designed by Fluidrive Engineering Company Limited, Worton Road, Isleworth, Middlesex, for use with the Paxman 6YHX Hi-Dyne oil engine, which has a constant output of 225 h.p. over a speed range of 650 to 1,250 r.p.m. Each fluid coupling has an impeller (connected to the engine) and a runner (the output member) which between them form a "working circuit." When the working circuit is filled with oil, the impeller acts as a centrifugal pump and transmits power by the kinetic energy of the oil. The locomotive was designed by Hudswell, Clarke and Company Limited, 14 Howick Place, Victoria Street, London, SW1.

Both impellers are driven by the input shaft of the transmission (refer to Fig. 1). The runner in the right-hand circuit (L) is carried on a solid shaft, which drives the low gear pinion, while the other runner (H) is mounted on the outer hollow shaft, which carries the high gear pinion, the two shafts being concentric. Thus, if circuit L is filled with oil (and H remains empty) the drive from the engine will be taken through the appropriate circuit to the low gear train and the locomotive will be in low gear. A change to high gear is effected by transferring the oil from the low gear circuit (L) to the high gear circuit (H), as a result of which the drive is transmitted to the high gear train, the low gear being disconnected. Because this change in gear ratio is effected by a transfer of oil from one fluid coupling to the other, the drive is maintained throughout the gear change. Similarly, a change from high to low gear is made by transferring oil from H to L.

The two-speed gear is of simple construction and consists of two pairs of single helical, hardened and ground gears. The high gear pinion (ratio 0·707 : 1) is mounted on a hollow shaft carrying the runner in the high working circuit and this hollow shaft surrounds the solid shaft upon which is mounted the low gear runner. The low gear pinion (ratio 1·414 : 1) is not secured to its shaft but runs freely about it. Low gear power is transmitted from the shaft by an SSS (synchro-self-shifting) clutch.

The Hi-Dyne/Dual Fluidrive combination is distinguished from all other diesel-mechanical transmissions by these features:

(1) Ratio changes up and down take place at predetermined speeds of the locomotive and do not depend on the driver's judgment. Handling of the locomotive is thus very simple. It responds immediately to the controls, even if the operator is unskilled.

(2) Because of the torque/speed characteristics, the ratio changes up to a higher speed gear are made smoothly without the marked drop in tractive effort present with a conventional engine and a stepped ratio transmission. A typical tractive effort locomotive speed curve is given in Fig. 3.

(3) A uniformly high horsepower is obtainable at the track over the entire speed range (see Fig. 3). Almost the full power capacity of the engine is thus continually available, with a proved low specific fuel consumption. The drawbar horsepower developed by the locomotive is more than 80 per cent of the gross horsepower output of the engine, a value claimed to be much higher than with other developed systems.

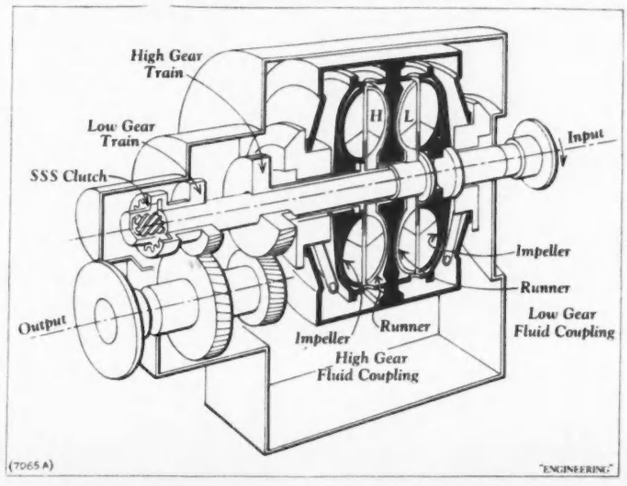
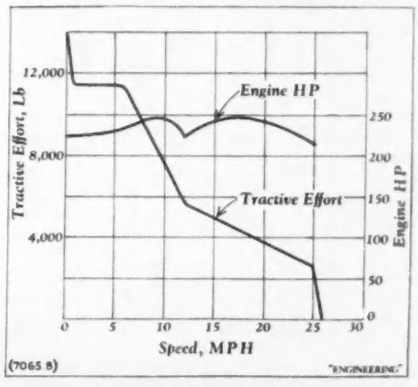


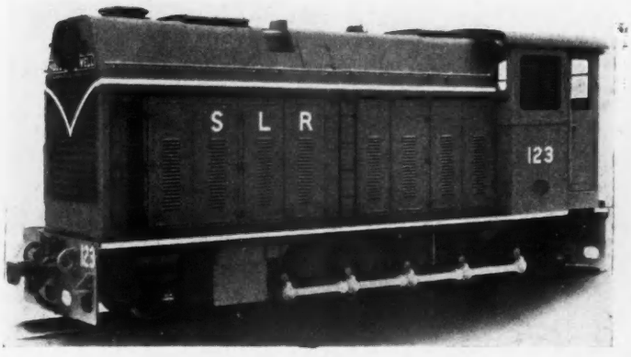
Fig. 1 (left) How the transmission works.

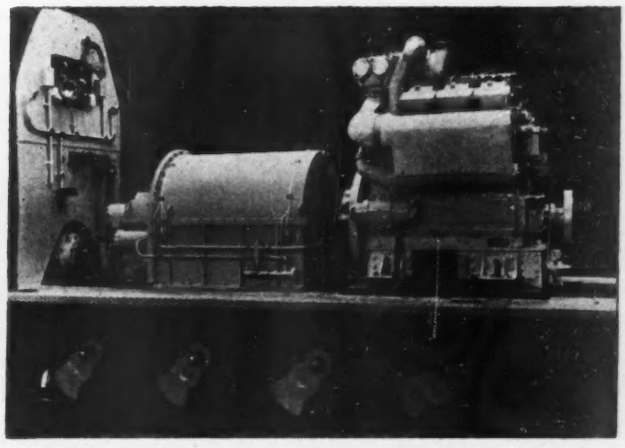
Fig. 2 (lower left) One of the diesel locomotives.

Fig. 3 (right) Performance characteristics.

Fig. 4 (lower right) The engine and transmission installation.





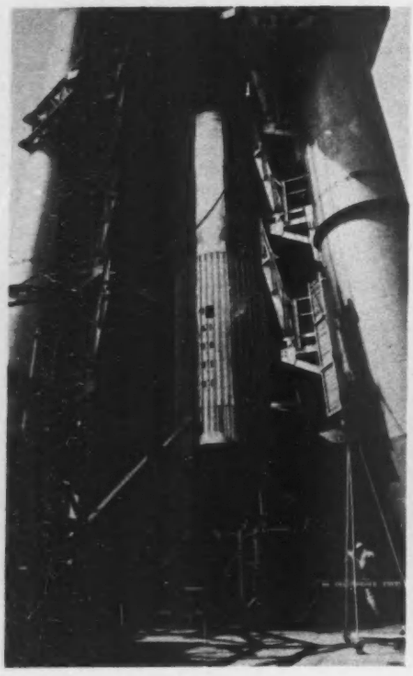


Gastight Seal for Rotating Shaft

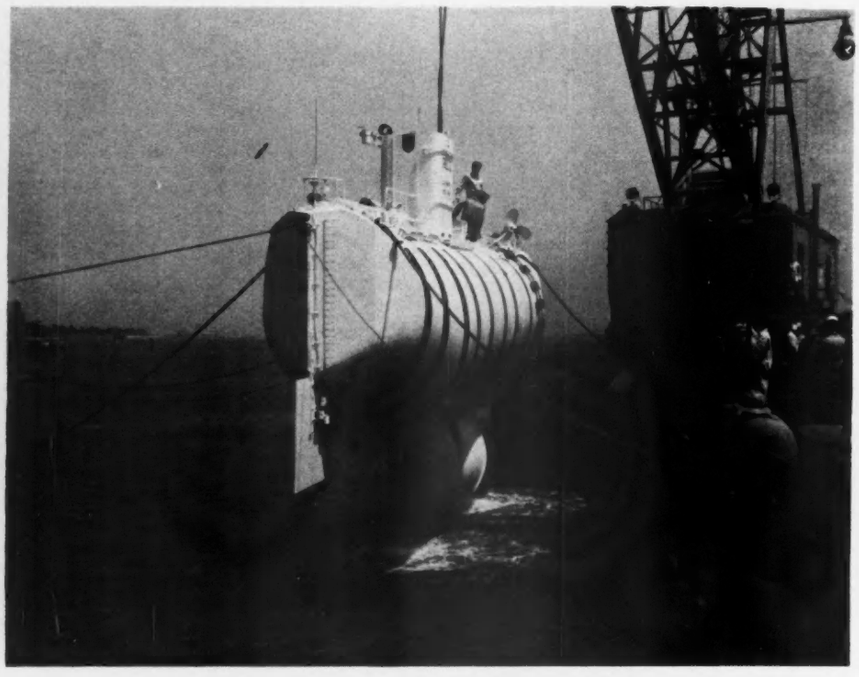
All ships intended for the carriage of petroleum and crude oil products are fitted with pumps to discharge the cargo. Unless these use saturated steam as a source of power—either piston pumps or direct turbine drive using saturated steam—it is necessary to separate the prime mover (superheated steam turbine, diesel engine or electric motor) from the pump by a gas-tight bulkhead.

The normal method of ensuring gas tightness where the driving shaft passes through the bulkhead has been to provide a stuffing box on the shaft linked in some manner to the bulkhead. This method has difficulties.

Recently Drysdale and Company Limited, Glasgow, W4, developed, and applied for a patent on, a method of sealing that avoids these difficulties. Instead of providing a seal between the bulkhead and the rotating shaft, this design provides for a seal between the bulkhead and the stationary bearing housing at the driving end of the pump. The seal is provided by a stainless steel bellows, such as is used for expansion pieces in steam pipelines. The ends of the bellows are firmly bolted to the bulkhead and the pump bracket and yet permit free relative movement of the pump and bulkhead within practical limits (about 0·040 in).

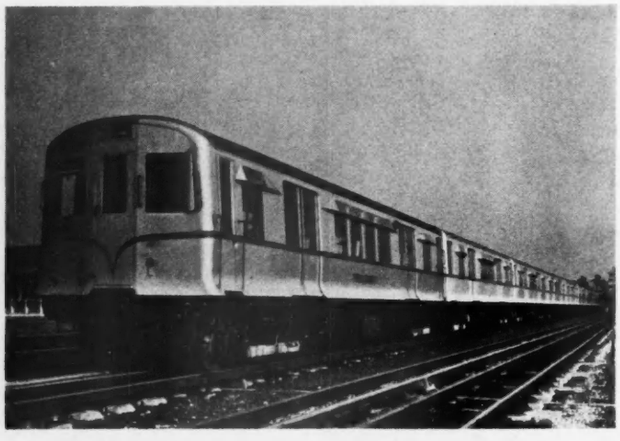


Blue Streak, the de Havilland long-range ballistic missile, shown in one of the test towers at Hatfield.

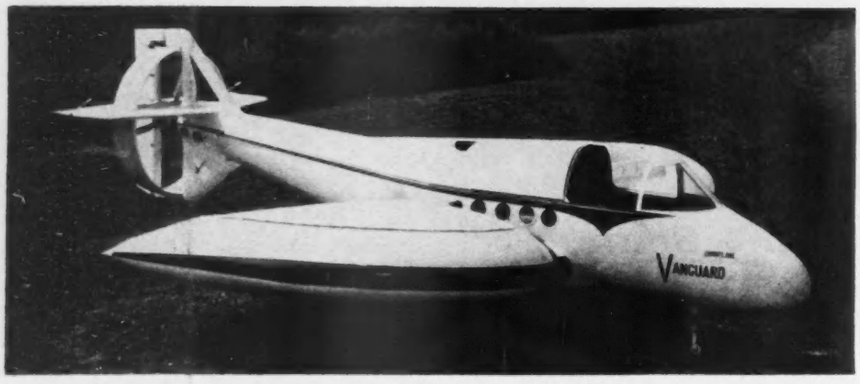


Self-contained underwater breathing apparatus (SCUBA), also known as the bathyscaph Trieste, one of the research tools of the US Navy Electronics Laboratory. It was designed by the father and son team of Piccard.

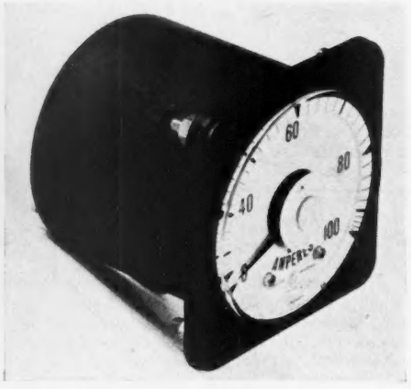
Track inspection in comfort is possible with this Fairmont Hydrail car (it is a Pontiac Chieftain) used by the Canadian Pacific Railway Company.



One of the three "Silver R" stock trains, in service on the London Transport District line, built by Metropolitan Cammell Carriage and Wagon Company.



Interesting vertical take-off and landing plane developed in the USA by Vanguard Air and Marine Corp. Known as the Omniplane, it has a rotor in each wing and one in the tail.



This Crompton Parkinson ammeter is a flush scale instrument with North American styling.

Marketing

BMC Carried On

While its thousands of operatives and staff were enjoying the season's festivities the oversea sales efforts of the British Motor Corporation were going on unchecked.

Three hundred ships were at sea over the Christmas carrying almost 16,000 BMC vehicles and parts for assembly (known as KD units). Of these ships, 58 were taking 7,000 cars to the United States and Canada, a volume of UK car export to North America that has never previously been carried on at this time of year. The destination of others of the BMC's New Year parcels were as diverse as Hong Kong, Australia, the British West Indies and ports in Northern Europe.

Petrochemicals in Australia

An ethylene manufacturing and purification plant is to be erected in New South Wales, Australia, by Shell Chemical. Towards the close of the year an agreement was reached between Imperial Chemical Industries of Australia and New Zealand and Shell Chemical (Australia) covering the new plant, which will be an extension of the existing refinery at Clyde, NSW. The ethylene produced at Clyde will be piped to the ICI Australia and New Zealand plant at Botany, already much expanded, where it is to be used in the making of polythene. The combined cost of the two extensions to plant will be more than £A10 million.

From the start of construction this year, the ethylene is expected to begin flowing within two years. From 6,000 tons in 1946, the world production of polythene, an ICI discovery, has soared to 700,000 tons in 1958. Many more applications of this versatile chemical are likely to have been devised by the time it is available from Botany.

South American Contract

A company of the Cementation Group is to carry out a £1,000,000 shipyard installation contract near Rio de Janeiro, Brazil.

The subsidiary, Cementation Brasil SA—Engedharia Civil em General, of Sao Paulo, is to handle the contract as a joint effort with the Perini Company of Canada.

The contract is for the construction of the first part of a new shipyard at Jacuacanga, and will include a dock and slipway, workshops and a jetty. The first work on the contract is being started.

Iron Foundry Record

Producing 2,423 tons of finished castings in the week that ended on 19 December, the iron foundry of Distington Engineering, a United Steel subsidiary, set a works, national and European record for one week's output from one iron foundry.

The castings included numbers of bottom plates, slag ladles, general engineering castings and 379 ingot moulds.

In each of the three previous weeks, output was above 2,000 tons. Distington's iron foundry is working on a 17-shift week. The use of a second hot blast cupola, with continuous tapping, allows a full week for furnace maintenance since one furnace is able to give all the iron required in a week's production.

The order book for the foundry is described as " very satisfactory " and the management are confident that the heavy demand which this record output is striving to meet, will go on well into this year.

Highland Power Stations

The North of Scotland Hydro-Electric Board's power stations at Glenmoriston, Inverness-shire, and Loch Glashan, Loch Fyneside, Argyll, are to have turbo-generating plant from the Harland Engineering Company and the AEI (Heavy Plant Division).

The vertical Francis turbine for the Glenmoriston station, with a rated output of 21,200 b.h.p., will be made by Harland Engineering, who will also make and install the main valve and associated equipment. AEI will supply the 15,000 kW generator. Automatic control from within the station and from outside will operate the plant.

The Loch Glashan station will have a horizontal Francis turbine of 8,500 b.h.p., from Harland, driving a 6,000 kW generator made by AEI.

Competition from Germany

News of stiffer competition for Britain's highly successful tractor exporting firms comes from West Germany. Klockner-Humboldt-Deutz, now the largest tractor manufacturers in the republic plan to expand their output at Cologne from 20,000 a year to 30,000. Since German tractors cost up to a fifth more than British, at the moment, the German firm also proposes to bring the price down by reducing costs. British tractor production has the advantages of coming from far fewer firms—140,000 tractors a year in Britain being made by five companies, against 120,000 a year in Germany by 30. Such developments from the continent are not likely to diminish the reluctance of leaders in the United Kingdom motor industry to take their expansion in capacity away from the Midlands and London to Scotland, Wales, or the north-west.

Sheerness Transition

The conversion of Sheerness naval dockyard into an industrial estate and port is likely to go with a speed that may keep further disruption in employment to a minimum.

The new owners of the dockyard, Building Developments Limited, are in touch with three firms and the Sheppey Development Committee, after a recent meeting with directors of Building Developments, reported itself satisfied with progress so far, and with the outlook for the future.

Unemployment in the area has so far risen far above the national average to 6 per cent.

Building Developments are to appoint a managing director who will conduct the future estate at first hand.

Special Purpose Equipment

The formation of a new company, Production Machines Limited, for the design and manufacture of special-purpose equipment and machines is announced.

Two companies have formed Production Machines, at Kenton, Middlesex, as a joint subsidiary. They are the Birmingham Tool and Gauge Company and North West Machine Design.

New Art College Building

The contract for the building of the new Royal College of Art, which is to rise between the Albert Hall and Queen's Gate in Kensington Gore, has gone to the Kensington firm of Leslie.

The new £500,000 college will be a nine-storey block with studios, workshops and administrative offices, part of the building looking out over Kensington Gardens. Facing the Albert Hall will be the main entrance and the exhibition gallery, made possible by a £75,000 Gulbenkian grant, the largest of any made by the Trustees in this country. The hall is to be known as the Gulbenkian Hall. Apart from its many uses for assembly and social activities it is hoped the hall will become a centre for the arts in west London.

The architects are Mr. R. Y. Goodden, Mr. H. T. Cadbury-Brown, and Sir Hugh Casson. Building, beginning early this year, is expected to be completed by October, 1961. The move in by the departments of the college should be accomplished by the summer of 1962, the 125th anniversary of the Royal College of Art.

The college's site was first allocated by the Government back in the 1930s.

The BP 600

After two and half years of activity in Canada British Petroleum now has 600 retail outlets in the Dominion. Seventeen bulk plants and terminals in the Quebec and Ontario provinces serve the retailers and three more are being built. The distribution of the heavier stove and furnace oils is being steadily built up. A new BP refinery is approaching completion at Ville d'Anjou, Montreal, that will be able to deal with 1,000,000 tons of crude oil a year.

Nearer home BP is putting down a second test well near Kimmeridge in Dorset. It is 2,500 ft west of Kimmeridge No. 1, where a show of oil was encountered about 1,800 ft down last March. A third and possibly a fourth test well will be drilled but the company emphasises that much work still has to be done before it will be known whether the oil at Kimmeridge may prove commercially viable.

From out of the way market towns to major international exhibitions such as the Technical Fair at Utrecht and Stockholm's St. Erik's Fair, the " BP in Agriculture " exhibition was travelling round Europe for six months of last year. Now it is estimated that the BP story was told to at least 250,000 visitors; an impressive piece of international public relations.

Tyneside Motor Expansion

Decisions are expected soon on the possible expansion in either Scotland or Wales of the big motor firms. Meantime Smith's Delivery Vehicles, of Gateshead on Tyne, who make specialised food vehicles, are finding such a demand for their mobile shops and other products that they have filed an application with the Board of Trade for a new 100,000 sq. ft factory on the Team Valley trading estate.

The rate of output in 1959 was lifted by a third over the previous year but the firm was still unable to meet the demand. A lighter battery, now made by Chloride Batteries, is expected to increase the applications of electric vehicles, which are one of Smith's specialisations.

The company make their own electric vehicle chassis, mobile shops and transport refrigeration equipment. Some Smith's Electrics, with petrol or diesel power, are made by other firms.

Kuwait Buys British

Three Westland Whirlwind helicopters have been ordered, as a follow up to the first, by Kuwait's president of civil aviation, Sheik Abdulla Mubarak Al Sabah, who is deputy ruler of the oil state.

The Whirlwinds have Pratt and Whitney R1340 piston engines. A wide range of additional equipment is going out with the Whirlwinds. It includes a Sproule air/sea rescue scoop net, flotation apparatus for amphibious operations, external freight gear, a winch hoist able to lift 400 lb and long range fuel tanks.

Kuwait has imported a great deal of modern equipment and luxury consumer goods with its vast oil revenues but the four Westland helicopters are the first in that country.

Freer Australian Imports

The process of relaxing import controls was taken one step further by the Australian Government last month by making an additional £A25 million available from the start of the new import licensing period just begun. This makes a total relaxation of £A75 million since last August.

The new import ceiling will be £A875 million a year. Within this overall limit the Australian Government have decided to remove discrimination against imports from the dollar area and from next October to lift all restrictions on imports of motor vehicles from the dollar area, restrictions which have been in force since 1936.

Mr. John McEwen, the Australian Trade Minister, explained that the new imports which would come into Australia as a result of the easing of restrictions would be mainly equipment and materials and would make a major contribution to the continued development of the Australian economy. It should make the task of British engineering firms with a substantial stake in the Australian market a great deal easier.

Radiographic Recording on Bromide Paper

The technique of recording radiographic phenomena directly on bromide paper, instead of special X-ray film, has many advantages. As yet, the technique is not very widely known, and some practical details are given.

By R. O. Couchman

Chief Radiologist, Kent Alloys Limited

The bromide paper radiographic recording technique[1] makes use of the fact that certain salts (e.g. calcium tungstate) will absorb a considerable quantity of X-radiation and that an appreciable amount of this radiation is converted into a blue-white light, to which photographic emulsion is especially sensitive. When using bromide paper only one screen need be employed. This is placed adjacent to, and in close contact with, the sensitive side of the paper, and may be used either as a back or front screen. Although some workers claim improved results are obtained by using a fluorescent back screen, it is usually better to use the screen in front, with the sensitive side of the bromide paper facing the tube. This gives an image which when viewed on a paper radiograph is seen as with the eyes looking-from the X-ray tube. This is consistent with the normal practice of viewing translucent radio graphs and has much to recommend it.

This recording technique can be said to have a number of advantages: it is a method of producing radiographs suitable for reproduction or for attaching to reports; it supplies radiographs suitable for viewing when no illuminator is available, e.g. visits to customers' factories; it gives a cheap method of fault detection when only coarse defects are being sought, e.g. loose debris in aircraft structures; it is a cheap method of checking for a known defect. Under or over exposure can be given to intensify the defect, e.g., tungsten inclusion in welds; it can produce a cheap stencil for locating the positions of known defects in castings or welds when repair work or investigation is being undertaken.

It must be remembered that the results can never be as sensitive as those obtained with normal X-ray film, and cannot be used for the detection of micro-porosity, cracks or other fine defects. However, in practice, defects can sometimes be seen and assessed more easily on paper radiographs than on films when a satisfactory illuminator is not available. Should a film be viewed by holding up to daylight, the excess light shining into the eyes of the viewer round the edges of the film tends to blind the eyes to detail. This is easily demonstrated by placing a whole-plate radiograph in the centre of an open 14 in by 17 in illuminator and gradually closing the masks to the edge of the film. Detail will reveal itself in an amazing manner.

The set-up for taking paper radiographs is fairly orthodox, and the usual precautions are taken for the prevention of scatter and back reflection. The loading of the paper calls for some special precautions and a glossy, single-weight, "hard contrast" paper should be chosen. This is placed in a rigid cassette so that the sensitive side is remote from, but facing, the X-ray tube. The front screen of a pair of salt screens is placed with the sensitive side adjacent to the bromide paper and nearest to the X-ray tube (front of cassette). This operation is carried out in a dark-room with suitable safelights for bromide paper. In this respect it should be remembered that safelights used for X-ray film are not necessarily safe from bromide paper.

Exposures are made in the normal way, using approximately the same high voltage as in radiography. Although X-ray film is some six times faster than bromide paper the difference in the relative exposures is not nearly so great. In practice it is necessary to expose film to a density of 1·75 for normal viewing by transmitted light, but paper, viewed by reflected light only requires a density of 0·75-1·0.

Rockley[2] claims that this difference in working density reduces the discrepancy between the two materials to a point where their working speeds are similar. However, it is generally found that some increase in exposure times is necessary. Exposure tables for aluminium and steel are given in Figs. 3 and 4.

Superior "blacks" are obtained by using the correct bromide developer rather than X-ray developer. Dish development is always used, as damage is easily caused to wet bromide paper processed in X-ray hangers. The prints should always be glazed as the extra light reflected by the dense portions gives increased sensitivity.

The cost of paper is approximately one-third that of X-ray film, but at the same time a significant loss of radiographic quality must be tolerated. Providing the results obtained meet the appropriate inspection requirements a considerable economic advantage is obtained by the use of the method described. It is said that the grain of the salt screens slightly blurrs the image,[3] mainly

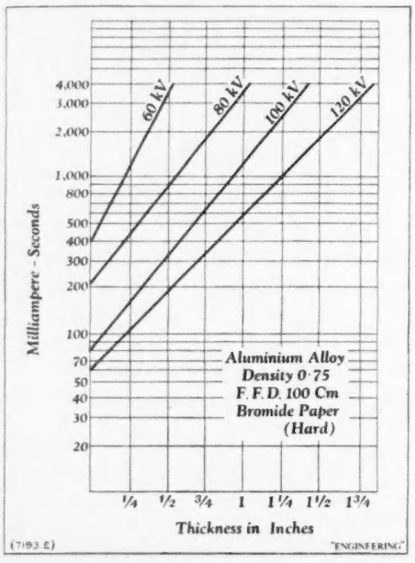


Fig. 3 Bromide paper exposure chart for aluminium alloys. This chart is based on a density of 0·75 on hard, glossy, single-weight paper.

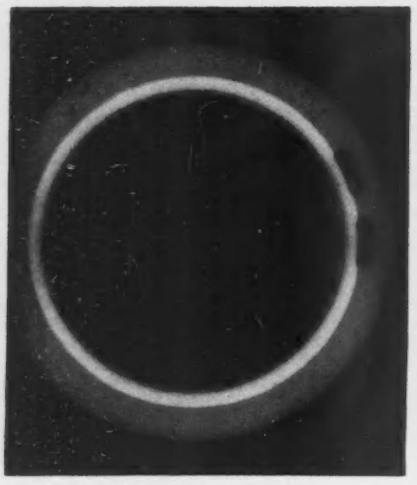


Fig. 1 Radiograph of clutch plate. A number of these plates reveal gas cavities on machining, and many machine hours can be saved by cheap radiographic inspection on bromide paper.

Fig. 2 The welded joints on the shanks of molten metal carriers must be checked at regular intervals. Paper negatives are not only cheaper for this but can be more readily inspected by operators.

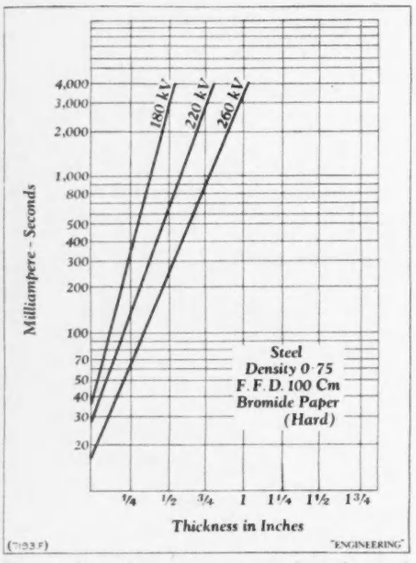


Fig. 4 Bromide paper exposure chart for steel. The details are similar to those given for aluminium alloys. Since the latitude is narrower than with aluminium, test exposures should be made before proceeding with quantity work.

because the grains scatter light in all directions. While this is largely true, it has been found that the standard of quality does not seriously reduce the ability of the radiograph to reveal relatively fine detail[4].

REFERENCES

[1] R. O. Couchman, "Copying Radiographs for Reproduction," p. 643, ENGINEERING, vol. 186, 14 Nov., 1958. London.

[2] J. C. Rockley, "The Use of Bromide Paper in the Radiography of Aircraft Structures for the Detection of Loose Debris," chapter 2.4, Ministry of Supply Report (unpublished) No. AID/NDT 1396.

[3] H. S. Tasker, *Handbook of Industrial Radiology*, Ed. by J. A. Crowther, chapter 4.11, 2nd Ed., London, E. Arnold, 1949.

[4] J. C. Rockley, "The Use of Bromide Paper in the Radiography of Aircraft Structures for the Detection of Loose Debris," chapter 4.2, Ministry of Supply Report (unpublished) No. AID/NDT 1396.

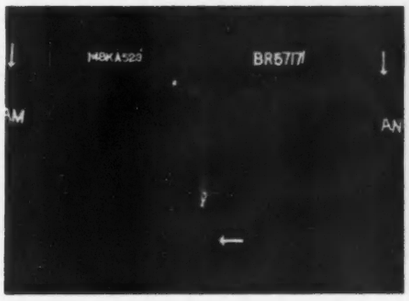


Fig. 5 A spot check on a long run of weld, showing tungsten inclusions. A considerable saving was effected by using bromide paper.

Fig. 6 This completely blind core in casting can only be checked by radiography. Paper negatives can be used to measure the wall thickness without the aid of a viewing cabinet.

Photographic Memory for Telephone Exchanges

A technique for storing information on photographic plates has been developed by the Bell Telephone Laboratories, USA, in connection with an experimental electronic telephone switching system. The permanent memory, as it is called, will store such things as directory information and instructions for the switching system, in the form of thousands of tiny dots on a photographic area of 4 sq. in. Seventeen of these areas are used to make up a complete photographic plate and the entire permanent memory store is comprised of four such plates.

The spots of clear and opaque film are scanned by a light beam which is generated by a cathode ray tube and focused by a system of lenses. The movement of the beam is controlled by an electronic and optical positioning system which gives it sufficient accuracy for the beam to pick out any one of the almost microscopically small dots. The permanent memory contains over two million bits of information, as opaque or transparent dots, and can read out a 68 bit word every two and half microseconds.

The store system itself is used to "expose" the information on to the plates, using the beam from the cathode ray tube. The spot from the beam is scanned over the entire 2 in square image area and stopped briefly at positions where a spot exposure is required. The photographic emulsion is slow enough not to be noticeably exposed by the passing beam. Each of the seventeen small areas on a plate is exposed individually, in sequence, while the other sixteen are covered by a system of shutters. An entire plate, containing 550,000 spot positions, can be exposed in less than three minutes.

Mechanical Engineering Research Progress

Issued under its old name, the 1958 report of the Mechanical Engineering Research Laboratory has now become available. In future, these reports will be issued under the establishment's new name, bestowed last April, of the National Engineering Laboratory. In summarising the progress made during 1958, Dr. D. G. Sopwith, director of the Laboratory, described several of the many topics dealt with by the six divisions of the Laboratory.

In the Materials division, one of the phenomena investigated during 1958 was that of creep to fracture under complex stresses. In their report of this work it is said that a limited amount of creep deformation may not matter in pressure vessels, steam pipes and similar structures as long as fracture does not take place. To design such structures economically it is necessary to know how the creep strain in the region approaching fracture is related to the applied stress at a given temperature. It is found experimentally that the criterion of fracture depends on the way that cracks form and grow in the material.

In copper at 250° C and a molybdenum steel at 550° C, for example, cracks form in the early stages of creep and grow relatively slowly during tertiary creep to cause eventual fracture; with these materials the criterion for fracture is the maximum principal stress. On the other hand, in aluminium alloy BS2L42 at 200° C cracking does not occur until immediately before the final fracture; here the stress criterion for fracture is the octahedral stress.

WATER TURBINE EFFICIENCY

Also reported by the materials division are the results of some investigations on methods of measuring the efficiency of water turbines. Since conventional methods of measurement involve high expense and interrupt the normal running of the equipment, other techniques have been tried out, and two of them found successful. These two methods rely on the principle that the energy losses in a hydraulic machine are converted into heat, and the rise in temperature of the water flowing through it is therefore directly related to the hydraulic efficiency.

In the first (thermometric) method, the temperatures at inlet and outlet are measured directly; thus requiring an absolute and accurate calibration of the thermometers. In the other (thermodynamic) method, a sample of water is drawn from the penstock and expanded adiabatically until its temperature is raised to that of the water in the tail race. The thermometers need to be matched carefully, but need not be calibrated absolutely. Accurate measurement of pressure is required in both cases.

Measuring equipment for the thermodynamic method has been developed by the University of Glasgow and is based on a Wheatstone bridge, incorporating a carefully matched pair of platinum resistance thermometers. So far, the equipment has been tried out at five hydroelectric stations, at heads ranging from 97 to 1,300 ft, and it has worked satisfactorily at heads above 300 ft. Further work is now in progress to extend its use to low-head installations.

LOCOMOTIVE WHEEL FRICTION

In the Lubrication division, interesting results have emerged from investigational work carried out on the adhesion between railway wheels and rails. Laboratory tests have suggested that the adhesion may be increased considerably by applying a solution of sodium metasilicate to the surfaces. Material collected from the surfaces of rails has been found to consist mainly of iron, iron oxides and silica. These particles have a large surface area and it seems likely that low adhesion occurs when organic materials have been adsorbed by them, and then moistened. This means that adhesion can only be effectively increased by removing the organic materials or rendering them harmless in some way.

By applying a solution of sodium metasilicate, and detergents based on it, the adhesion coefficient can be raised to 0·35. This is quite adequate for practical purposes since railway design is usually based on a coefficient 0·25, which is the average for dry, untreated rails. To obtain a high adhesion coefficient permanently, the residue remaining after chemical treatment has to be removed. This can be done effectively with either steam or water.

AIR LUBRICATED BEARINGS

Further work has been done in the Metrology division on the design and applications of air bearings. Although it has been possible for some time to design air bearings which will work reasonably well in a particular application, insufficient data is available as yet to enable optimum design to be obtained from the point of view of stiffness, load and economic air consumption. Design data have therefore been produced for a versatile type of flat air bearing, operating under steady loads. Empirical relations have been obtained from which bearing area and size of orifice can be determined for a given static load and air gap; the bearing stiffness and air flow can also be calculated.

The maximum load-capacity of the type of bearing tested is approximately one-third of the product of the bearing area and the air supply pressure. It is not affected appreciably by the diameter of the orifices, which have to be set back a little from the surface to obtain maximum load-carrying capacity. The bearing stiffness, however, is independent of orifice "set-back" or supply pressure for a given load, but depends on orifice diameter.

These data have been used in the design of an air bearing to take the place of the normal slideways of a horizontal milling machine. The modified milling machine can be said to operate satisfactorily, since a very much smaller motor is required to drive the machine table and "stick-slip" friction is eliminated. From this it appears that air bearings may have an important affect on future machine tools.

Copies of the 1958 Mechanical Engineering Research Laboratory Report are obtainable from HMSO, price 4s 6d.

Machine Tools

Following a steady decline in both new orders and deliveries during 1958 and the early part of 1959, the machine tool industry has now begun to turn the corner and may look forward to a steady improvement in demand, though the improvement will probably be slow at any rate during the first half of the current year. The industry is faced with some difficult problems of organisation if it is to maintain its competitive position in the long term. Now that the election has removed any immediate threat of nationalisation it may be hoped that the industry will become less sensitive to criticism and will give serious thought to the lines along which future development should proceed.

Although most manufacturers of machine tools reported some revival in orders as early as March last year, except in the single month of May, the value of new orders received continued to run below deliveries and at the end of July the value of orders in hand, at £48·9 million, was the lowest recorded for several years. This figure compares with £54·4 million at the end of 1958, £78·5 million a year earlier and £98·4 million at the end of 1956. A position of near stability was, however, reached at the end of April, 1959, and over the four months May to July, the decline in the value of orders in hand amounted to only £1·0 million, and this was very largely made good in August at the end of which orders in hand stood at £49·8 million. Comparing the first six months of 1959 with the corresponding period in 1958, it would seem that export orders fell to a smaller degree than orders from the home market since the former declined from about £8 million to about £7·5 million and the latter from £33 million to £27·5 million.

In spite of the declining order book, the industry continued to increase deliveries until the early part of 1958, but for the whole of 1958, total deliveries at a monthly average of £7·0 million, compared with £7·9 million in 1957 and £7·1 million in 1956. The lowest point was reached in the second half of 1958, for which the average was £6·5 million per month. Since then the quarterly figures indicate a very slight recovery from a monthly average of £6·4 million in the fourth quarter of 1958 and the first quarter of 1959 to £6·7 million in the second quarter. Deliveries in the first six months of 1959 were still well below those for the corresponding period in the previous year. Deliveries in the third quarter of the year normally show a seasonal decline due to the incidence of holidays, but it seems probable that the figures for the fourth quarter, when available, will show an improvement over the previous year for the first time since 1957.

Exports

Exports of machine tools in 1959 are estimated at about £22·0 million which compares with £24·2 million in 1958 and a peak figure of £28·1 million in 1957. The decline was due mainly to a fall in exports to Commonwealth countries, particularly to India, resulting largely from that country's balance of payment difficulties. There have been some encouraging reports recently that overseas demand for certain specialised types of British machine tool is growing, particularly in the USA and Germany.

The prospects for a continued expansion of orders during 1960 must be judged to be reasonably favourable. The revival in orders which has already taken place has stemmed mainly from manufacturers of components for motor vehicles and for consumer durables such as refrigerators, vacuum cleaners and other household appliances. There may possibly be some falling off in demand for machine tools from the second category since there is some evidence that the boom in consumer durables is levelling off. Motor vehicle manufacturers have, however, announced plans for considerable further expansion of capacity over the next few years and this is likely to result in a steady demand for new machine tools.

The prospect for a really substantial increase in home orders for machine tools must depend on the progress of the revival in demand for products of other branches of the engineering industry. The index of production for the engineering and allied industries as a whole showed very little change over the four years 1955 to 1958 standing at 110 in the former year and 112 in the latter. Since a number of companies undoubtedly had expansions to capacity in hand in 1954 and 1955 it must be concluded that at least until about the middle of last year there was considerable surplus capacity in many branches of the industry. Since April, 1959 the index of production has resumed its advance and has been running at about 8 per cent above the level for the previous year.

A factor which may possibly have some effect on home market orders for machine tools is the reduction in import duty in November 1959 from 17½ per cent *ad valorem* to 10 per cent. The higher rate had been accompanied by an arrangement, now terminated, under which the user could get the duty remitted if he could establish that no comparable tool was available from British manufacturers or that the delivery date was too long. A number of big specialised machines were imported free of duty under this arrangement. The alterations were suggested by the Machine Tool Trades Association, which includes importers among its members, largely because the provisions for duty free importation led to friction with customers, who in many cases did not know with certainty in advance whether a particular purchase would be subject to duty. Imports of machine tools in 1959 were relatively low and are estimated at about £16·5 million compared with £17·7 million in the previous year.

Manpower

The trend of activity in the machine tool industry is clearly reflected in the employment statistics though the fluctuations have been less severe than those in the figures for deliveries of machine tools. Many producers of machine tools are subject to competition for skilled labour from other branches of the engineering industry, notably the production of motor vehicles, which in times of prosperity can afford to pay high wages. There is a natural reluctance to reduce the labour force unless this becomes absolutely necessary. In the period leading up to the peak demand of 1957, difficulty in expanding the labour force was one of the main factors limiting the output of machine tools and could again become a bottleneck in the event of a marked increase in demand. Throughout 1957, the numbers employed in the production of machine tools and of engineers small tools stood at rather over 120,000. The figure fell slightly in the early part of 1958 and the lowest point was reached in July 1959 when the figure stood at 109,300. The decline in employment was thus just under 9 per cent, compared with a fall in output of about 19 per cent. After July 1959 there was a partial recovery to 111,200 by September.

A survey of the machine tool industries of Western Europe by Professor S. Melman which is discussed in greater detail below, suggests that for certain classes of tool substantial savings might be made in labour requirements through greater concentration and standardisation of production. It may be doubted whether the market for standard types of machine tool at present available to British manufacturers is sufficiently large to enable the full economies to be made but there is probably scope for considerable improvement in the labour situation through increased concentration of production which should not only reduce the total labour force required for a given output, but also permit manufacturers to pay higher wages and thus compete more strongly for skilled labour.

The Machine Tool Trades Association recently took an important step by the provision of scholarships for engineers on the staff of member companies to attend a two year full time course on machine tool design which is being organised at the Manchester College of Science and Technology. Previously, training in design was available only through practical work within the industry though a good deal of work has, of course, been done both at Manchester and elsewhere on, for example, the theory of metal cutting and machine tool performance. The scholarship scheme is intended to ensure tha problems of machine tool design are approached from fundamental principles as well as from development through experience of existing ideas. It has been pointed out that the machine tool industry employs only a very small number of university graduates and therefore the new course is not formally designated as post-graduate though the standard is intended to reach that of a post-graduate course. The course will cover a number of general subjects such as hydraulics, friction and lubrication, control engineering and developments in engineering materials in addition to subjects more specifically related to machine tools.

Plant and Product

Towards the end of 1959, the machine tool industry was subjected to considerable criticism directed specifically to the organisation of the industry, alleged inadequacy of the amount of research undertaken and lack of standardisation. These criticisms were based on the supposed contents of three reports on the industry, none of which has yet been published. The first of them, covering the structure and performance of the industry, was prepared by the Board of Trade for discussion at the National Production Advisory Council for Industry at the request of the Union leaders on the Council.

The second was prepared by Professor Melman for the European Productivity Agency and is concerned with the machine tool industry throughout Western Europe and the USA. Although this report also has not been published, Professor Melman has stated his personal views in press interviews and through a broadcast by the BBC. The third report which covers research and development within the industry was prepared, with the collaboration of the industry itself, by the Department of Scientific and Industrial Research.

One of the main points made by Professor Melman was that owing to the existence of a large number of relatively small companies making a limited number of specialised tools and lack of standardisation, the industry throughout Western Europe and in the USA may find itself at a competitive disadvantage *vis-à-vis* the Russian and Eastern European machine tool industries. Following Professor Melman's broadcast, Mr. F. H. Harris, the secretary of the Machine Tool AACP team which visited the USA in 1951 to study productivity in the industry, commented that Professor Melman's main criticisms were much the same as those contained in the AACP report, though the representatives of the industry on the team had never agreed the relevant section of the report. Mr. Harris suggested that a committee should be set up to recommend steps to be taken to lead to quantity production in the industry and that consideration should be given to a scheme similar to the cotton industry concentration scheme designed to close down a number of the smaller machine tool manufacturers. He also suggested the establishment of a central machine tool design research organisation to carry out research on machine design as distinct from research on cutting techniques and tools.

While Professor Melman's criticisms were not specifically directed at the British machine tool industry, he gave a number of examples of machine tools which he said were being produced in Russia with an expenditure of between one-fifth and one-third of the manhours required in Western Europe. No doubt, as pointed out by the Machine Tool Trades Association, this applies only to relatively few types which are required in large numbers by Russian industry. Nevertheless, if the figures quoted are correct, Russia may shortly be in a position to supply basic machine tools to undeveloped countries at very low prices. It may be doubted whether it would be possible to reorganise the British industry alone in order to enable it to compete in these particular fields, though if some accommodation can be reached between the EEC and the Free Trade Association countries this might well lead to a high degree of specialisation in machine tool production and a substantially improved competitive situation for Western Europe as a whole.

There are grounds for believing that the British machine tool industry would benefit substantially from a measure of concentration. Some recent comparative statistics prepared with the cooperation of manufacturers' associations in the countries concerned show that in 1958, 480 manufacturers in the UK produced machine tools valued at £83·9 million, while in Western Germany, 500 manufacturers had a combined output of £153·5 million and in the USA 500 manufacturers an output of £204 million. This is not the whole story since there appears to be virtually no difference in output per employee as between the three countries and such differences as do exist may be due at least in part to differences in the types of machine tool manufactured. Output per employee in Switzerland is, for example, very much higher than in the major machine tool producing countries and this is primarily due to Swiss concentration on high precision tools.

On the question of research, it is expected that after the DSIR report has been discussed by the industry, recommendations will be made early this year for strengthening, where necessary, the organisation of research and possibly increasing expenditure on it. Some earlier DSIR figures published last year showed that in 1955-56 the machine tool group of industries spent some £761,000 on research or 0·7 per cent of turnover. While a number of branches of the engineering industry spent relatively less on research this compares with 19·4 per cent of turnover in the case of the aircraft industry, 4·8 per cent for radio and telecommunications, 3·2 per cent for electrical engineering, 1·8 per cent for scientific, surgical and photographic instruments and 1·3 per cent for general mechanical engineering.

The MTTA last month agreed to give further consideration to the type of research organisation most suitable to the industry, following a meeting with representatives of the Department of Scientific and Industrial Research.

Materials

While the machine tool industry is strongly dependent on an adequate supply of skilled labour, it is less dependent on supplies of high priced or scarce raw materials than are many other branches of the engineering industry. In the last census year, the value of purchased materials and fuel represented under 35 per cent of gross output for the machine tool industry compared with nearly 45 per cent for mechanical engineering. The principal raw materials used by the machine tool industry are, on a value basis, iron castings and steel angles, shapes, sections, etc., which together account for over a quarter of total material purchases.

During 1959, total deliveries of finished steel to the industry were running at the rate of about 47,000 tons per annum compared with 52,000 tons per annum in the previous year. The industry appears to have reduced its stocks of steel by about 10 per cent during the first half of 1959, but this probably represents an adjustment of stocks to the declining volume of work in hand, rather than any difficulty in obtaining supplies.

Research

Over the past decade, automatic control techniques have been extensively applied to machine tools, giving rise to a completely new class of equipment known as numerically controlled machine tools. Normally, these are general purpose machines which are controlled by paper or magnetic tape, thus allowing a whole programme of cutter movements to be changed simply and quickly. For instance an electronically controlled milling machine is capable of carrying out work which would normally lie within the capacity of the machine when controlled by a skilled operator, but the work can be done much faster, at lower cost and with considerably extended facility. The range of tools so far controlled in this way includes lathes, profiling machines, various types of milling machines, shaping machines, flame cutting machines and hole drilling and boring machines.

In spite of all these various developments, there are signs that the British machine-tool industry is not keeping pace with some of its foreign competitors. British machine tool manufacturers are perhaps most vigorously attacked for their lack of effort in developing special purpose tools and the extent to which such tools are imported shows that the criticisms are substantially true.

If a new research association is set up it will be likely to follow the pattern already set by the thirty or so research associations of other industries. As a rule, these associations start in a small way and, consequently, it sometimes takes a long while for them to become fully useful. Many of those already in existence are working on budgets so small that their work is less effective than that undertaken by the big firms. This can create a general lack of confidence and can result in the progress of the association being appreciably retarded. It seems unlikely that this would be the fate of an association started by the machine tool industry at this stage.

Although they are very late starters in the research race, the mere fact that there are so few large firms who would not support it or who would embarrass its efforts by highly superior work of their own, may mean that the machine tool industry will have one of the most effective cooperative research associations in the country.

Design

Some machine tools have undergone very little change since they were first introduced, the centre lathe being a case in point. The design is basically the same in principle, consisting of a rigid bed carrying a fixed headstock at one end and a movable tailstock at the other. The main modification has been in regard to the indication of the tool position in relation to the work.

Traditionally, this has been measured by rotating an engraved dial to show increments of movement. The great disadvantage of this method is that the operator has to read a finely-divided scale on a highly reflecting metal surface. He also has to do some mental arithmetic as well and from time to time check the work by calipers or micrometer. An interesting device produced by English Numbering Machines Limited, and developed by C. B. Gibbs at the Applied Psychology Research Unit in Cambridge, gives a continuous and direct statement of the diameter of the work. The unit can be built into a new machine or added to an old one. Tests show that this indicator enables an inexperienced operator to increase his output by 42 per cent, and an experienced one by 73 per cent. The device can be used on many other machine tools.

It is probably in the control of machine tools that there has been the most development, and several new control systems were on view at the 6th European Machine Tool Exhibition in Paris last September. One was the Ferranti Mk IV transistor-hydraulic control for three-dimensional continuous machining. The complex information needed for this work is processed by a digital computer and recorded on magnetic tape. Because of an improved method of recording, three hours machining time is possible on one tape. The transistorised units are built-up from standard interchangeable units, and this makes the equipment easy to maintain. Hydraulic servo motors that develop 3 h.p. are used for the machine drive because they have greater stiffness than the electric servos previously used. The measuring system employs photo-electric scanning of shadow bands from a pair of stainless steel diffraction gratings. A Tapemaster vertical drilling machine equipped with this device made it clear how much easier it is to machine intricate components without expensive and complicated masters. The system was also demonstrated on a Contourmatic contour milling machine. This gives high precision with high spindle speeds and feed rates, for a long capital cost.

There were also examples of two-dimensional coordinate control systems such as the system by EMI which is of the dial and tape analogue type. This was shown automatically positioning a 30 in rotary table to an accuracy of 3 sec of arc with a repeatability of 1 sec for an unlimited number of angular settings. Société Genevoise Limited had an automatic repeating device on their Hydroptic jigborer. The coordinate settings on this machine are obtained from two nickel-plated steel scales machined and engraved to high standards of of precision.

An interesting Canadian-designed automatic machine tool has been developed by the Sperry Gyroscope Company of Canada Limited. This is a device for positioning a table, carriage or tool post within tolerances of $\pm$ 0·0005 in on one or more axes. On short travels, accuracies of $\pm$ 0·00025 in are possible. Motions are repeated over and over again with a repeatability accuracy of $\pm$ 0·0001 in. Drilling and straight line milling, turning and grinding, can all be controlled in sequence, by programming through a punched control tape. Positioning directly from dials, without the use of tape, is available as an extra. The system can position machine components at rates up to 200 in a min, in all axes. Highly accurate linear transducers in the control provide measurements completely independent of, and unaffected by, conventional transport mechanisms. With the type of tape reader used, there is no need for a shift register or memory store and so the bulk, and cost, are greatly reduced.

A specially designed hydraulic valve contributes greatly to the overall positioning accuracy at high travel speeds. Other types of machine drive can, however, also be controlled precisely.

The system is most suitable for short production runs, where starting costs are usually very high.

Other interesting trends include the use of the building block principle, already referred to above. One British firm, T. S. Harrison and Sons Limited, have used the method on one of their small milling machines, and as a result have been able to sell it competitively. From Germany comes the Elga-Record automatic gas brazing machine, made up of a rotating table carrying 20 rotary plates on its periphery. Blowpipes fed with fuel and oxygen are mounted on an adjustable vertical support column, so that each plate can rotate near the flame. A single operator can produce 2,500 parts an hour with this machine. A range of chucks is made by James Neill and Company (Sheffield) Limited. These Eclipse chucks, as they are called, have a number of permanent magnets surrounded by coils which magnetise them to saturisation. This means that the workpiece and the holding mechanism are magnetised together.

Shipbuilding

The year 1959 finished with a welcome and marked recovery of tramp shipping freights. The index for November stood at 83·1, a level not attained since August 1957. The index for time charters also reached the highest figure since November 1957, though at 63·4 the recovery has not been so great. The rise was sustained from September in which month the tramp index stood at 71·0. At the same time the total of laid up tonnage in the world fell sharply. The total gross tonnage of laid up vessels (tanker and dry cargo) on 1 December was 6·9 million compared with 8·3 million a month previously.

These improvements follow a year of increasing gloom in shipping circles. The slight rise in tramp freights in the latter part of 1958 had not been maintained; the laid-up tanker tonnage which dropped from its 1958 peak of 5·87 million tons to some 4 million tons due partly to the seasonal winter demand for oil, rose again once the winter was passed; and steadily more pessimistic forecasts were made.

In May of last year, a Japanese shipping company, Iino Kaiun Kaisha, forecast that even under the most favourable conditions, there was likely to be a substantial surplus of oil tankers until 1962. The assumptions behind this estimate were that world demand for oil would increase at an average rate of 6 per cent per annum, that all oil tankers 25 years old or more will be scrapped and that about 30 per cent of the war tonnage built between 1943 and 1945 (a total of 10¾ million deadweight tons) will also be scrapped. This would put out of commission some 7½ million tons of the existing fleet. The scheduled deliveries of new tankers in the period 1959 to 1963 inclusive are estimated at 26¾ million tons.

It is also assumed that 20 per cent of the tankers on order for independent tanker owners will either be cancelled or converted to dry cargo, amounting to 1·86 million deadweight tons, by the end of 1963. The result of all this would be a net growth of the world tanker fleet of 13 million tons to 71·3 million tons by the end of 1963.

If this should prove true, it holds out scant hope for a shipbuilding recovery based on tanker construction. The forecasts suggest a rate of tanker delivery falling steadily from 7 million tons in 1959 to 4 million tons in 1963.

In the first nine months of 1959, British shipyards received orders for 129 ships, totalling 146,000 gross tons. During this period, cancellations totalled 141,000 gross tons. The industry's order book at the end of September totalled 514 vessels of 4·47 million gross tons. This may be taken as about three years' work for the larger yards, though there are already some smaller yards which are virtually out of work. This order book is still the largest in the world.

For some years, the annual tonnage launched has been steady at about 1·4 million tons. During the 12 months to the end of September 1959, completions reached 1·42 million tons; launchings, however, fell to 1·31 million tons, and tonnage laid down, 1·18 million tons. Lloyd's Register of Shipping point out that fluctuations are part of the general pattern of these figures, but that a period analysis showed a general trend towards lower output. This trend is not of course confined to the UK alone.

During the third quarter of 1959, tonnage commenced in all foreign countries amounted to 1·53 million tons, launchings to 1·78 million tons, and completions to 1·55 million tons. The figures for each of these headings exceeded 2 million tons for the June quarter of 1958; the current output is the lowest for two years, and tonnage commenced is the lowest for three years.

The Japanese shipyards at the end of September had orders for 2·86 million deadweight tons. The greater part of this consisted of supertankers of 30,000 deadweight tons or more. Eight of the 24 yards had a backlog of orders sufficient for only six months' work, while only seven could look forward to more than a year's work. The yards have been forced to dismiss about 15,000 temporary workers, thus reducing the labour force to 71,000 regular employees and 14,000 temporary workers. Some comfort for Japan's competitors may be taken from the warning by the Transportation Ministry against cut-throat competition to obtain foreign orders; at the same time, the Japanese Government has decided on aid to the yards to enable them to offer even longer-term payment in negotiating deals than has been the case hitherto.

The present UK shipbuilding situation is somewhat paradoxical. Unless the current upturn in freight rates proves to be more than a mere seasonal fluctuation, the shipping industry is faced with a surplus capacity both in tanker and dry cargo tonnage, which is likely to persist for one or two years at least. In such a situation, nobody wins. Large amounts of capital are kept locked up in idle tonnage, saved from the breakers' yards in the hope that rates may rise just sufficiently to enable a little more useful work to be squeezed from it. The presence of this reserve fleet means that any worthwhile increase in rates will be quietly damped down by more ships being brought into service. In such a situation, wholly uneconomic rates are being accepted merely to save vessels from complete idleness.

So long as this persists, shipowners in general will be doing well merely to hold their own. Since a considerable part of the laid up tonnage is old and uneconomic, its return to service would not be so very profitable except where the ships have already been written off. Faced with the plain fact that there are too many ships, the only two possible answers are either to scrap the surplus or to stop building. In the absence of international agreement it is all too likely to be the latter course that is adopted, with the two consequences that valuable shipyard labour is liable to be dispersed and that the shipowners are left with an ageing fleet.

British shipyards may perhaps be rather better placed than their major competitors, though the advantage is relative and tenuous. In the first place British shipbuilding has a very large home market. Since British buyers have suffered rather less than others in the present setback, their future orders are less likely to be affected. In the second place, provided—and this is a large proviso—too many important orders are not cancelled within the next year, the slower rate of construction in British yards may work to their advantage; shipowners may reckon that by the time vessels are delivered, the worst of the recession may be over. This is almost entirely dependent on the view taken by the British shipping industry; very few orders have been received from foreign sources in the past eighteen months.

British shipyards have frequently been accused of failing to adopt modern methods; they have been, perhaps too frequently compared with yards such as the Japanese specialising in bulk carriers. While such methods undoubtedly bring quick results during a boom, it may well be asked whether a more broadly based industry, such as the British, is not better able to weather a recession.

It remains to be seen what will be the ultimate effect on passenger lines of the growth of air transport. Present day orders for new liners placed with shipyards suggest confidence on the part of the shipping lines. A total of 12 lines of over 18,000 tons are currently under construction, amounting to 370,000 tons and valued at nearly £150 million. Eight of these, totalling nearly 250,000 tons, are for British owners.

As has long been the case in air transport, national prestige has become a major factor in passenger shipping. Of these 12 liners, only the British vessels will be wholly financed by private capital. The question of subsidies has been discussed at length in the case of the proposed Cunard replacements for the Queens. This can hardly be discussed apart from air transport. Passenger travel across the Atlantic by air has now surpassed the volume of that going by sea. It may well be questioned whether it is in the real national interest to subsidise surface transport to help draw away traffic from the (subsidised) air lines.

Manpower

An industry in difficulties is a natural target for criticism; and though the main difficulty is not of its own making, shipbuilding has had more than its fair share of critical comment during the past year—levelled both at management in general, and labour relations in particular.

The year has produced a further crop of disputes, and another much-publicised demarcation strike at Cammell Laird. In view of the bitterness engendered by this type of dispute in general, it is important to try to put it a little in perspective. A study of the economics of shipbuilding in the UK has shown that the direct cost of all disputes (including those over demarcation) was less than a half per cent of labour costs for the period 1950 to 1956; though particular disputes are very damaging for the individual yards in question the overall effect on the British shipbuilding industry must be regarded as small. Further than this, according to Mr. E. J. Hunter, chairman of Swan, Hunter and Wigham Richardson, at least 95 per cent of demarcation questions are settled in the shipyards by common sense and goodwill. Mr. Hunter stressed that a false impression had been given by the publicity attached to the few isolated cases where stoppages had occurred. These, laughable as they appeared in the eyes of some people at home and abroad, were not representative of the industry as a whole.

Fortunately, following the end of the Cammell Laird dispute in July there were some signs that attempts would be made to reach a long term agreement on this subject. Proposals for a general inquiry into labour relations in the industry were countered from the union side by a demand that such an inquiry should be limited only to particular yards. It would seem more likely that a general inquiry, including yards where relations were good, would stand more chance of supporting the unions' contentions than otherwise.

Some considerable discussion arose on the return of a UK shipbuilding productivity team from Sweden towards the end of October. The Swedish shipbuilding industry has enjoyed five years of complete freedom from any official or unofficial strikes. The trade union member of the team, Mr. Ted Hill, of the Boilermakers Society, suggested that this was the result of closer contact between employer and employees. One suggested other reason is the fact that in Sweden the whole shipbuilding labour force is governed by one union only as opposed to the multiplicity of unions in the UK. This may well be a reason though it should also be recalled that it is not unknown for demarcation disputes to arise within a particular union in Britain.

This particular visit should lead to more constructive thought. The general level of productivity in Swedish yards was stated to be considerably higher than that obtaining in the UK and costs to be no higher in spite of the fact that the general level of Swedish shipbuilding wages is about 50 per cent higher. Demarcation disputes were again raised as a possible reason for this though this argument was fairly conclusively refuted. A more plausible argument was later raised that in fact the explanation seemed to lie in large part in the high standard of managerial skill displayed by the Swedish shipbuilders. The particular aspect cited was the willingness of Swedish shipbuilders to accept

standardisation, concentrating on sequences of vessels of similar construction with consequent savings in production costs. This may be so; the same argument, however, applies here as in any comparison between UK shipbuilding and that of Japan. Sweden, as Japan, prefers to turn out oil tankers and bulk carriers which lend themselves far more to standardised production than do the vessels for the most part constructed in the UK.

To summarise, it is fairly clear that there is no simple answer to the troubles which even if they are isolated have continued to bedevil the UK shipbuilding industry. What is fairly clear to an outsider, however, is that attitudes appear to have frozen into a pattern of behaviour which is far more suited to the problems of the 19th century than to the present. Attitudes which lead to disputes of this kind are very seldom wholly or even in small part reasonable, being based mainly on fear and mistrust. Such attitudes can only be broken down by patience and preferably lack of publicity. It is to be hoped that the basis for progress in this direction has been made this year. Before being too critical of shipyard workers whose memories go back to the depression of the thirties, it is worth recalling that between 1930 and 1933 the output of ships from British yards fell from 1,478,563 tons to 133,115 tons. The fact that the general economic background now is utterly different from that time can easily be ignored in maintaining traditional militant attitudes.

Plant and Product

The shipbuilding productivity team on its return from Sweden claimed that the UK industry had little to learn from that country in the way of technique, but that new techniques were slower in being introduced in this country. A reason given for the slow rate of modernisation here as compared with the continent, has been the need not to interfere with commitments to buyers, during the boom years following the war.

More recently, a number of modernisation schemes have been put in hand, not only in the larger yards, and a number at least of these schemes are continuing, despite the gloomy outlook for the immediate future. An example is the yard of Charles Connell and Company, where about £1 million has been spent on modernisation since the war, and where a second programme over the past two years will allow the construction of ship up to 65,000 deadweight tons. Cammell Laird have this year completed the first stage of a reconstruction scheme which will cost a total of £18 million. The first stage has included facilities for prefabrication. A considerable part of the reconstruction undertaken in British yards has been directed towards providing capacity for larger vessels. Schemes of this type attracted particular attention with the advent of the supertanker. With the present depressed tanker market, such investment may not pay off in the immediate future. The ability to build the largest vessels will, however, be an important factor in maintaining this country's share of a reviving market —whenever this occurs.

The size of passenger vessels still appears to be a subject of controversy. It is argued on the one hand that the day of the giant transatlantic liner is over. To judge from vessels at present under construction, this is not the case, though the extent of Government subsidies argues that on economic grounds it should be. The question of the replacement of the Cunard Queens has become a sufficiently weighty matter for the appointment of a special Government-appointed committee to examine the Cunard proposals. That the idea of the mammoth liner is not dead is shown by the indefatigable Messrs. Cantor and Detwiler, who are still canvassing their proposals for liners of 90,000 and 100,000 tons to carry up to 8,000 passengers. Both these proposals were reported during the past year as being somewhat nearer becoming a reality.

Materials

In a period of declining activity, raw material supplies are unlikely to constitute a major problem.

Of interest is the steadily increasing use of aluminium alloys in shipbuilding. The use of light alloys for superstructures is by now well accepted. The total quantity of aluminium used in the United States for example, was some 2,000 tons of which about 1,400 tons were used structurally. A much-publicised British example was the Oriana, which used a total of about 1,100 tons. The Canberra, now under construction at Belfast, has so far absorbed more than 1,000 tons purely in structural work, so that the total including fittings, trim and ornamentation, is likely to approach that used in the United States.

Aluminium is certain to become a steadily more important raw material in shipbuilding. Its use in hull construction has up to the present been limited mainly to small boats. In November, however, a freighter for river traffic was launched in Germany with an aluminium hull. The carrying capacity of 1,160 tons, was claimed to be more than 120 tons greater than if steel had been used. On the other hand, the cost was about one-third higher than that of a comparable steel vessel.

Research

A change came over shipbuilding design with the use of welded hulls instead of riveted hulls. The change from rivets to welds was originally to save steel, since a riveted (or bolted) joint needs plates that overlap, while a welded joint has plates edge to edge. There are many other advantages of welded construction, probably the most important being that it allows prefabrication of the parts. Components can be constructed under cover, quite a distance away from the ship's berth, the size of the component often being dictated only by the size of crane available. This means that work can go on, unhampered by bad weather. In addition, welds are stronger than riveted joints, and the time taken to construct a welded ship, and the cost, is less. The weight of a welded hull is less than that of a riveted one; in fact, for a small welded tanker, the saving in weight can be as much as 30 per cent. The welded hull also offers less water resistance.

A new shipyard now being built by A.B. Götaverken at Arendel, near Gothenburg, Sweden, is being laid out for line production. Materials from the stockyard will pass by conveyor, through the preparation and prefabricating shops, to a large automatic welding shop lying across the width of the yard. Here the subassemblies of the welded ships will go to one of two parallel building lines that extend out of the shop and run the length of two dry docks, each able to take a vessel up to 100,000 tons d.w., or two smaller vessels side by side, of course. As sections of the ship are completed and the ship takes form, the stern will be moved into the dry dock on steel rollers. When a certain amount of hull has been completed, some of the machinery will be installed and internal fitting started. This work will proceed while the rest of the hull is being completed, all being planned to finish at the same time, that is, when the bow of the ship leaves the assembly shop. The planned output of the yard is from 180,000 to 300,000 tons d.w. a year, depending on the size of ship. The total building time for a 40,000 ton tanker should therefore be of the order of 20 weeks.

At the same time that shipyards have been reorganised to suit welding techniques, the opportunity has been taken to install better equipment, such as, high capacity machines for cold straightening, rolling, flanging, folding and pressing steel plates and bars. Quite a lot of flame-cutting equipment has been put in operation and automatic welding is used extensively in conjunction with X-ray and other forms of non-destructive testing. In addition, machines for shot-blasting plates to remove scale and optical methods for marking plates are gaining popularity.

The basic metal for hull construction is still steel, improved varieties being used so that full advantage can be taken of welding. Timber cannot be improved on for certain parts of the structure, but lifeboats, for instance, are now made of fibre glass. Light alloys are getting popular for deck houses and structures generally in the upper parts of the hull, the advantage of using them being the reduced top weight and the improved stability with a minimum beam. This was done on the 40,000 ton Orient liner Oriana, the largest passenger ship built in Britain since the Queen Elizabeth, launched last November at the Barrow in Furness shipyard of Vickers-Armstrongs Limited. It has an all-welded aluminium superstructure consisting of five decks, two bridge decks and all upper works, complete with internal structures. Welding was carried out by hand and automatic machines using the argon gas-shielded metal arc process.

Plastics are employed for many parts of the structure and unit construction is gaining popularity for blocks of cabins, bathrooms and so on.

Design

Some of the finest ship-testing equipment in Europe was made available to shipbuilders and naval architects when the National Hydrodynamics Laboratory was opened last year by HRH the Duke of Edinburgh.

Forming part of the Ship Division of the National Physical Laboratory, the facilities are at Feltham, Middlesex. The most noteworthy items are a 1,300 ft towing tank and a 44 in water tunnel.

The dimensions of the towing tank (1,300 by 48 by 25 ft) give it many advantages. In the first place its length enables testing times to be reduced, because several different ship speeds can be simulated in one run along the tank. Also, larger models can be used, and this overcomes the difficulty of accurately making model propellers and at the same time reduces "scale-effects" on the measurements. The depth of the tank (25 ft) enables tests to be carried out on submerged models of submarine cargo vessels, should this be necessary.

The problem of propeller cavitation has become most important in recent years and it is possible that the 44 in water tunnel will have its main use in this connection. Since propeller cavitation is critically dependent on the exact geometry of the blades, the 24 in diameter models that the tunnel will accommodate will contribute to greater accuracy of results and a better all-round understanding of the problem. Hydrofoils, rudders and stabilising fins are also subject to cavitation and the tunnel has facilities for studying and measuring the cavitation patterns and forces of such devices.

Quite a lot of thought has been given here and in the USA and by UNESCO, to the design of a comprehensive ocean-going research ship. Opinions differ on many points as to size and method of propulsion, but all seem to agree that plenty of space should be devoted to the scientific aspect, providing this is not at the expense of accommodation. This means that a large ship would be necessary.

Most countries are not too keen to build a large research ship, either because of the cost of building it or the cost of running it. Of course, one great advantage of the large ship is that she can be at sea in all weathers. The advantages of being on the spot, ready to start work as soon as the weather improves, has been proved time and time again in the Royal Research ship Discovery II, the displacement of which is 2,100 tons. The ratio of scientists to crew in this ship is 1 to 4, which is low by American standards, but such a value is reasonable for a deep water, all-purpose research ship, able to work away from home for months at a time, with its resident team of scientists.

Mining Machinery

Mining machinery prospects can be considered in relation to three main user industries. These are coal-mining, the petroleum industry and other mining industries (mainly overseas). Petroleum is given a separate classification since the refining side can be partially considered as a home industry. The prospect of these three groups of user industries are quite distinct although, especially in today's context, the prospects for machinery in coal-mining are related to those in the petroleum industry since competition between coal and fuel oil is now outstandingly acute.

So far as the outlook for mining machinery in UK coal-mining is concerned, prospects are closely related to the implementation of the National Coal Board's revised scheme for the coal industry set out in *Revised Plan for Coal* issued in October 1959. This document introduced a drastic revision in the capital investment programme for the coal industry. Briefly, the main features of the new scheme for the industry according to the *Revised Plan for Coal* are as follows:

The estimated demand for coal both in the home and export market has been reduced from a target of about 240 million tons a year by 1965 to about 215 million tons. This involves a reduction in manpower from 652,000 at the end of August 1959 to an estimated figure of between 587,000 and 626,000 by 1965. So far as capital expenditure is concerned, total outlay over the decade 1956 to 1965 was forecast in the NCB's booklet *Investing in Coal*, published in 1956, at £1,000 million. This figure included however replacement of existing machinery and other types of equipment. Actual expenditure between 1956 and 1959 is estimated to have been £380 million leaving a balance of £620 million to be spent in the following six years. According to the latest plans however, the estimated expenditure over these six years is expected to be only £445 million. That is to say, the original target for the decade of £1,000 million has been reduced by 17·5 per cent to £825 million.

TABLE—*UK Orders for Petroleum Equipment*

1958	£ million
1st quarter	32·5
2nd quarter	27·9
3rd quarter	29·2
4th quarter	32·5
1959	
1st quarter	29·2
2nd quarter	27·5

The figures given above are at 1955 prices. If these are put on to a 1959 basis, the forecast total capital expenditure of £445 million becomes £511 million. Of this, £440 million will be spent on collieries, excluding ancillary activities. This will be an average annual rate of expenditure over the next six years of £73 million. In 1956 capital outlay under this heading was £76 million; in 1957 it was £84 million; and in 1958 it was £90 million. There is thus quite a significant drop forecast for the next few years and it was made clear in the early part of 1959 that part of the cut-back will be taken by mechanisation in the mines including outlay on mechanical equipment below ground including power loaders and conveyors. The mining machinery industry is therefore likely, overall, to have a smaller turnover with the coal mining industry over the next five or six years than it has had over the last three.

So far as the prospects for that part of the mining machinery industry which caters for the petroleum industry are concerned, prospects are rather better. The petroleum industry has been through a period of recession ever since the onset of the 1957 recession. There has been a world surplus of crude oil and during 1958 and for part of 1959 a series of cuts were made in world oil prices. The decline in world demand resulted in a slow-down in the rate of capital investment by the world oil industry and this cut-back included all aspects of investment from exploration of new reserves to installation of refinery capacity both on the oil fields and near the main consumption centres. In 1959 the prospects for the petroleum industry have improved somewhat.

There is some indication that demand in the United States over the next year will resume its upward trend, possibly at the rate of about 5 per cent per annum, while in Western Europe the rate of increase should be somewhat greater, probably between 8 per cent and 9 per cent per annum. Demand will thus begin to overtake supply but the prospects of potential demand reaching what oil producing countries would consider to be an optimum level is not likely to be achieved in the forseeable future. To the major oil exporting areas of the world, namely the Middle East and South and Central America must soon be added two large areas which are about to have exportable surpluses—Russia and North Africa. At the same time the United States has placed quota limitations on the importation of oil. It is therefore unlikely that the rising world demand for oil will be able to put such pressure on existing supplies and refining installations that a very large impetus will be given to the turnover of the oil equipment manufacturers. The recent trend can be seen from the table.

These figures show that in the first half of 1959 orders were running at some 6 per cent below the level for the corresponding period of 1958. A good deal of this equipment also was for chemical plant and not for the extraction or refining of crude petroleum.

Exports

In 1959 exports of mining machinery probably totalled about £9 million and of this most went to the British Commonwealth and South America. Apart from the petroleum industry, the main outlets for exports are to the gold mines of South Africa, the copper mines of Rhodesia, to the mining industries of India and to a much less extent to West Africa and the East Indies. Haulage engines and winders play an important part in the Indian market and in any case political considerations and the state of India's foreign exchange reserves are the main factors in deciding the level of imports. Political considerations apart, the UK mining machinery industry is dependent to quite a significant extent on the prospects of the mining industries in the Commonwealth where German competition grows increasingly acute. Here the critical issues are the price of world minerals including gold. Prospects for gold are unexciting at the present time. There is a world ceiling for the price of gold which means that increased profits can only be earned by either increasing the economies of production (and there has been a good deal of success with these in the more efficient mines in the last few years) or in striking richer seams of gold.

The prospects of an increase in the price of gold at the present time are almost non-existent. The last crop of rumours about an increase in the gold price was in the winter of 1957/1958 at the onset of the American recession and the development of the UK balance of payment crisis. This crisis blew over in both countries and there has been no talk of a change in the price of gold for some time. So far as other minerals are concerned, the prospect for 1960 is for a gradual increase in prices and in the case of copper there may be some rather violent movements of prices in both directions following the large fluctuations in the price in the closing months of 1959. This is a passing phase, however, and copper prices are likely to move up slowly along with lead, zinc and other non-ferrous metal prices.

Manpower

The mining machinery industry makes its main impact on human relations problems in the UK coal industry. Despite the reduction in the level of capital investment in the industry between now and 1965, the National Coal Board expects mechanisation to help bring about a significant further increase in the level of productivity. There has already been a steady rise in the level of productivity over recent years. In 1958 output per man-shift was 25·3 cwt. This is expected to reach between 30 cwt and 31 cwt by 1965. This is quite a realistic target since the rate of increase (a figure which has not been published as yet but which is alluded to in the *Revised Plan for Coal*) is higher than will be necessary to hit the target. If this figure is achieved with the help of mechanisation there will be a corresponding reduction in the number of miners employed. If total demand for coal by 1965 is of the order of 250 million tons (which for the time being is the estimated top figure for that year) the corresponding labour force required will be only about 626,000. It is expected that this reduction can be brought about mainly by natural wastage but this may not be true in all the coal divisions. The big declines will be expected in the Northern Division (which covers Northumberland and Cumberland), Durham Division, Lancashire Division and the Scottish Division. The Divisions least likely to be affected are East Midlands and West Midlands.

The impact is, therefore, most likely to be felt in those areas which already tend to have a rate of unemployment above the national average. It is expected that the great majority of men under 65 displaced by the closure of old pits will be found work in other collieries within reasonable travelling distance of their homes and the closure of collieries will so far as possible be phased so as to give the greatest opportunities for this to be done.

There are stern days ahead both for the management and men in the coal industry. The capital expenditure programme has been cut and it is no longer national policy to raise as much coal as possible at any price. The profit and loss account is beginning to make an impression on the coal industry even although it is nationalised, even if the discipline is only indirect. The result must be that management will have to plan and administer the industry with much less latitude as regards ordering new equipment and both management and men will have a direct interest in cutting costs. The industry knows that if it is to survive even with a reasonably large hard core of customers no matter how acute the competition from fuel oil may be, costs must be reduced or managers and men will lose their jobs on a larger scale than has been planned up to the present time.

Plant and Product

Curtailment in capital expenditure in coal is aimed at slowing down the rate of mechanisation, not in bringing it to a halt. Trends which have been developing over the last few years in the installation of certain types of equipment will continue if at a slower rate. By 1958 the East Midlands Division was producing about 25 million tons of coal a year by mechanised methods, followed a long way behind with 12 million tons by the North Eastern Division. Most other divisions were producing between 2 million and 6 million tons each with the aid of mechanised equipment. It is not likely that recent trends will be upset and there is still much scope for mechanisation. 1959 figures are not yet available but it is probable that the pattern which had been set up over the years to 1958 will continue for some time.

Anderton Shearer Loaders accounted for

40 per cent of the total mechanised output in 1958, followed by the Meco-Moore cutter-loader with 15 per cent of mechanised output. Then came the Trepanner as the third most-used power-loading machine. It accounted for 7 per cent of mechanised output in 1958 and is likely to improve its position over the next few years since it produces an appreciably larger proportion of big coal.

Other trends which have been established are likely to continue. Two of these are the reduction in the weight of explosives used per ton of coal and the extended use of methods employing compressed air or Cardox or Hydrox cartridges to break down coal. The use of pneumatic picks has been declining slowly but steadily for some years and this trend is likely to continue. In 1957 (the latest year for which figures are available) the amount of coal raised by coal cutters was 210 million tons whereas that raised by pneumatic picks was only 15 million tons. Of recent years there has been a tendency for the number of road conveyors to increase steadily whereas the number of conveyors installed at the coal face has been fairly steady. This trend is likely to go on since the total output of coal is not likely to increase (a factor which will affect the number of conveyors installed at the coal face), while the increasing use of horizon mining tends to increase the length of roadway between shaft and coal face and therefore the opportunities for installing road conveyors. On the other hand it has been found in some large pits that underground locomotives are more economic than roadway conveyors and it is probable that the number of locomotives, both diesel and electric battery types, will increase further in the next few years.

Work on coal preparation is likely to continue in accordance with recent trends. More facilities for washing and screening coal are still necessary as the proportion of coal raised by mechanical methods increases. This need is likely to persist for some time and is not likely to be offset by the tendency for some newer types of equipment below ground to produce larger types of coal. The NCB is also pressing on with its work on smokeless fuels. On the other hand the modernisation and reconstruction of the industry's carbonisation plant is about completed. There are now 29 coking plants in operation compared with 53 in 1947, the reduction in the number of plants being accompanied by a slight increase in total output.

Materials

Work with alternative metals to steel has gone on in mining for a long time. Efforts have been made with aluminium, as in the construction of cages, and there have been innumerable small developments with hardened alloys. Of recent years these have been the two major breakthroughs with new materials. The first was the substitution of pvc for rubber which has now been generally carried out on underground conveyors in this country and the annual rate of increase of just over 1 per cent in the coal industry's mileage of face conveyors and the 6 per cent in roadway conveyors is likely to go almost exclusively to pvc. The second was the substitution of hydraulic props for timber ones which is now going forward on a large scale, steel having established a decisive advantage over timber in the newer pits where substitution is economically advantageous.

No changes on a similar scale seem to be imminent. Automation and radio control of machines offer new techniques of control rather than scope for new materials. Somewhere in the future lies the possibility of harnessing atomic energy for controlled underground explosions but that is some distance away. Between then and now changes may be less spectacular, though nonetheless significant. New alloys, light-weight non-ferrous alloys, anti-fire impregnation techniques and better controlled shot firing are the probable lines of advance. Some day too, underground gasification in the UK may be practical on a really large scale, but not in 1960.

Research

Safety in mines is, by an overwhelming margin, the most important research subject in the field of mining technology. In this connection engineers and metallurgists make an important contribution by their researches into the best materials, and methods of construction, for mechanical plant and equipment; such as haulage machinery and devices used to control the roof and sides of coal faces, all of which may suffer extensive deterioration during service. The study of the cause of deterioration has recently been providing valuable information about matters such as the efficacy of the periodic heat treatment, which is required by law to maintain the mechanical properties of cage suspension gear.

At the Safety in Mines Research Establishment, Sheffield, work in these fields is extremely active. One of the many subjects of their recent researches is that of the effect of wear on the strength of chain links. In parallel with investigations into the effects of temperature and humidity on the ability of chain materials to resist abrasive wear, theoretical and experimental stress analyses are being carried out to determine the effect of wear on the stress distribution and strength of simple chain links, pins, shackles, etc.

One of the main criteria used for the selection of materials used in the manufacture of colliery haulage gear is its potential resistance to embrittlement, due to strain ageing or faulty heat treatment. Experience has shown that the Izod impact test for wrought irons and steels at room temperature gives some indication of the dynamic load behaviour. However, a material showing full ductile fracture at one temperature may exhibit an appreciable proportion of brittle fracture at a slightly lower temperature.

If Izod notched bar tests are carried out at various temperatures they reveal the range in which there is a transition from totally ductile to totally brittle fracture, and the relative merits of irons and steels whose impact fractures at room temperature are either totally brittle or totally ductile in appearance can be assessed if this temperature range is known.

In addition to these highly practical forms of research and development, a certain amount of fundamental research is conducted at SMRE, most notable of which has lately been on the subject of metal fatigue. Many metals fail if they are exposed to oscillatory strains, even if these strains are much too small to cause failure in a single application. This phenomenon, known as metal fatigue, has not yet been adequately dealt with in a theoretical manner, although a number of theories have been advanced. Most of these theories assume that movement of "dislocations" in the crystal lattice is an essential process. This assumption can be tested by experiments on single crystals of metals, whose dislocations are so oriented that they cannot move when the crystal is strained; if the assumption is correct then these crystals will not fail in fatigue. Such crystals can be grown as metal whiskers. When such whiskers are below about ten microns in diameter they are capable of sustaining elastic strains of as much as 5 per cent. SMRE has prepared whiskers of copper and iron and has designed experiments to test the theories by subjecting the whiskers to large elastic oscillatory strains.

Although developments in mining methods and machines are made necessarily slow by the difficulty of making tests under real conditions, the pace is definitely increasing and, thankfully, the safety aspect is by no means being overlooked.

Design

Modern equipment is essential for mining of any kind to be successful throughout the world. To meet competition, new machines are needed and technical progress vital. The Mining Machinery Exhibition, sponsored by the Council of Underground Machinery Manufacturers and held at Olympia, London last year, showed that Britain is well to the fore. The exhibition attracted 24,000, more than 2,000 of whom were from abroad. The object of the exhibition —there were 110 exhibits in all—was to make known to the world at large the products of the British manufacturer of underground machinery and ancillary equipment.

It was abundantly clear from the exhibits that British mining machinery manufacturers are well able to serve both coal and metal mining insofar as: drilling, roof support, underground materials handling, transportation, hoisting, electrical gear, ventilation, pumping and drainage, and illumination, as well as the generation of compressed air or electric and hydraulic power. The emphasis was on automatic and semi-automatic rigs for coal production and the development of electric motors of 60 or 70 h.p. for seams that are only about 18 in high. Incidentally, most of these motors are made by the machinery manufacturers themselves. Another major change is in the field of hydraulics. Hydraulic power is also used in drill, picks and traversers.

One of the greatest difficulties in shaft sinking is the presence of water-bearing strata in which the flow is often in excess of 200 gallons per min, and, in some cases, more than 1,000 gallons per min. In underground tunnelling, too, there are problems in working at the substantial depths at which the main reserves of coal are now to be found. There have, however, been marked improvements in the general rate of shaft sinking and tunnel drivage.

A symposium on shaft sinking and tunnelling was held last year, at the same time as the Mining Machinery Exhibition, under the auspices of the Institution of Mining Engineers. In one of the papers, the subject of tunnelling in British mines, and the equipment and methods used by the National Coal Board, were dealt with. It was stated that, with existing equipment and a high standard of organisation, 10 or 12 yd of tunnelling a day can be kept up for long periods. Some improvements in this speed might be possible, particularly in tunnels of small cross-section, but this would depend on new equipment. In another article, on tunnelling in Canada, it was explained that the hand-held, airleg mounted drill continues to be the most efficient drilling equipment where short holes and small cross-section tunnels impose limitations. In larger tunnels, and low-angle seam mining with sufficient headroom, the caterpillar-mounted, short boom shovel has proved most efficient, with a minimum repair cost.

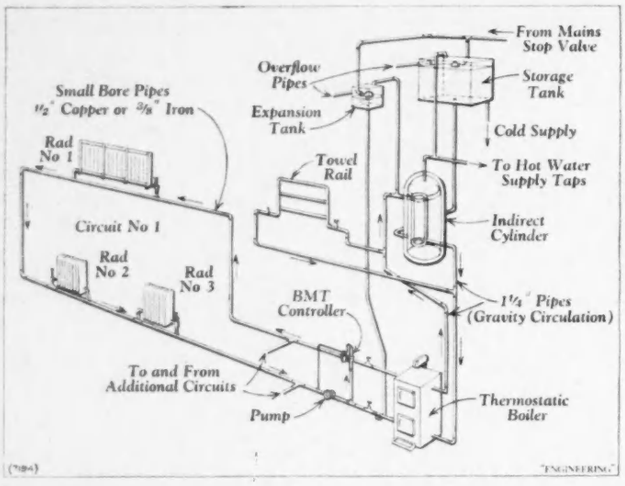
In Germany, the American system of using drill jumbos with heavy percussive drills is being replaced by the Swedish method of using medium-weight percussive drills on jack-legs. There is then less likelihood of stoppages, since several percussive drills are used at the same time so that a defective one can easily be replaced. In addition, the equipment is more readily adapted to changes in rock formation, the setting-up times are less, and so is the cost. In South Africa, investigations are being carried out into the use of drilling rigs, with the idea of cutting down the drilling time and the possibility of obtaining a more uniform round section for the shafts. It is of interest, also, to mention the tunnels under construction in the USA on the Missouri River in South Dakota. These use a continuous mining machine called a "mole," which is equipped with an inside and an outside cutting head, travelling in opposite directions, which excavate the material and transport it by belt conveyor to the hauling unit. This machine is most successful for it can bore 150 ft a day: it is really a development of the Beaumont tunnelling machine used for the pilot boring of the English Channel tunnel some 90 years ago. A new machine is now being developed in Czechoslovakian and Soviet laboratories and testing mines, with sections for sinking, clearing and lining, all functioning simultaneously.

Small Bore Heating

One of the major advantages of the small bore central heating system is that it can be installed in existing houses at reasonable cost. Indeed, the installation costs are not greatly different for new or existing houses.

As its name implies, small bore heating systems use tubes (usually copper) of small nominal bore (½ in) to circulate hot water to radiators distributed round the house. A further basic difference to conventional gravity systems using large iron pipes is that the water is circulated by a small pump so that flow is not dependent on temperature difference. A difference of about 20° F between flow and return is the normal value with the small bore system. Since the circulation is positive, warming up times are reduced and the whole system is quicker to respond to changes in outside temperature.

The system is not particularly new but has been developed steadily during the past ten years. Its full development rested on the production of suitable small pumps, sometimes called accelerators, that could be incorporated in the pipework and which would run silently without any attention over very long periods. This need is met by the glandless canned rotor type of unit which is completely sealed and has its bearings lubricated by the water it is circulating.



Small bore heating systems are economical to install and simple to operate with automatic controls. A separate indirect system should be used for domestic hot water supplies. Forced circulation gives quick response to demands.

A typical system is shown in part in the diagram. One or two more circuits can be added to reach other parts of the house. In general the normal house will not want more than three major circuits, with perhaps a short loop to feed a radiator in the hall. It is essential that the domestic hot water supplies should be obtained from an indirect cylinder so that the two systems, though operated from one boiler, do not interfere with one another. The arrangement also prevents scale formation in the boiler and damage to the pump.

There are three other important points to be taken into consideration when installing a small bore system. The boiler must have a large enough output to supply the double load of the radiators and of the hot water demands (most conventional circular type boilers cannot); the boiler should have a thermostatic control to prevent overheating should the pump fail and also to conserve fuel during warm periods; and there should be an automatic controller in the circuit to adjust the temperature of the circulating water to suit the outside temperature. The last usually takes the form of a mixing valve that allows some of the cold return water to bypass the boiler. The system lends itself to automatic operation independent of the fuel used in the boiler.

Installation of the system using ½ in bore copper pipes is very simple. Since the circulation is forced, there is no need to worry over levels; the pipes can run up over the tops of doors or drop down to pass under the cills without greatly affecting the flow, although too many bends will introduce friction losses and demand a larger pump than would otherwise be needed. Since the system is virtually a closed one, there need only be air vents at the highest points to release air during the initial filling.

Being small the copper pipes are not unsightly even if left bare. But their small size also means that it is comparatively easy to encase them. A simple extension to the skirting or an enlarged picture rail is sufficient. In keeping with the system, panel type radiators can be used, fed either from below or from above, the pipes in the latter case running down beside the window frame and at least partially concealed by the curtains. Skirting heating units can also be used in place of radiators. Pipes are normally fixed in stand-off clips which give a clearance to the wall of about ⅜ in.

As mentioned earlier, a separate indirect system should be used for supplying domestic hot water. The diagram shows the tank with the heating cylinder installed within it working on the normal gravity principle from the boiler. The circuit can conveniently include a towel rail for the bathroom. Apart from the removal of interference problems caused by the varying demands of the two systems, the indirect cylinder acts as an accumulator to take up excess heat from the boiler in the event of a sudden drop in the central heating load until the boiler controls readjust themselves.

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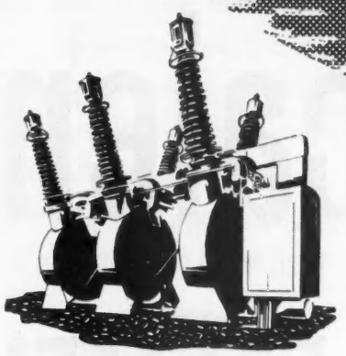
15,000 MVA
275-kV 2,000 amp
Switchgear
for
THORPE MARSH
C.E.G.B. Northern Project Group



The main switchgear at the THORPE MARSH Power Station will be supplied by the A.E.I. Switchgear Division.

The switching station will include thirteen 275-kV, 15,000 MVA, 2,000 amp oil circuit-breakers of the lenticular tank type, which will be the first circuit-breakers of this rating to be ordered for installation on the C.E.G.B. 275-kV system.

• • • AEI • •

The circuit-breakers will be generally similar in design to those supplied for the Kariba (Rhodesia) project.

For further information on this type of Switchgear write to A.E.I. Willesden Works, Neasden Lane, London N.W.10

Associated Electrical Industries Limited
SWITCHGEAR DIVISION
Willesden, London · Trafford Park, Manchester · Higher Openshaw, Manchester

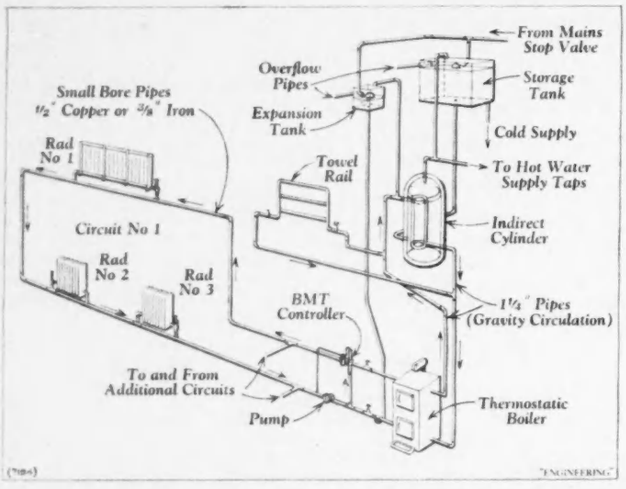
FA/909 H

Small Bore Heating

One of the major advantages of the small bore central heating system is that it can be installed in existing houses at reasonable cost. Indeed, the installation costs are not greatly different for new or existing houses.

As its name implies, small bore heating systems use tubes (usually copper) of small nominal bore ($\frac{1}{2}$ in) to circulate hot water to radiators distributed round the house. A further basic difference to conventional gravity systems using large iron pipes is that the water is circulated by a small pump so that flow is not dependent on temperature difference. A difference of about 20° F between flow and return is the normal value with the small bore system. Since the circulation is positive, warming up times are reduced and the whole system is quicker to respond to changes in outside temperature.

The system is not particularly new but has been developed steadily during the past ten years. Its full development rested on the production of suitable small pumps, sometimes called accelerators, that could be incorporated in the pipework and which would run silently without any attention over very long periods. This need is met by the glandless canned rotor type of unit which is completely sealed and has its bearings lubricated by the water it is circulating.



Small bore heating systems are economical to install and simple to operate with automatic controls. A separate indirect system should be used for domestic hot water supplies. Forced circulation gives quick response to demands.

A typical system is shown in part in the diagram. One or two more circuits can be added to reach other parts of the house. In general the normal house will not want more than three major circuits, with perhaps a short loop to feed a radiator in the hall. It is essential that the domestic hot water supplies should be obtained from an indirect cylinder so that the two systems, though operated from one boiler, do not interfere with one another. The arrangement also prevents scale formation in the boiler and damage to the pump.

There are three other important points to be taken into consideration when installing a small bore system. The boiler must have a large enough output to supply the double load of the radiators and of the hot water demands (most conventional circular type boilers cannot); the boiler should have a thermostatic control to prevent overheating should the pump fail and also to conserve fuel during warm periods; and there should be an automatic controller in the circuit to adjust the temperature of the circulating water to suit the outside temperature. The last usually takes the form of a mixing valve that allows some of the cold return water to bypass the boiler. The system lends itself to automatic operation independent of the fuel used in the boiler.

Installation of the system using $\frac{1}{2}$ in bore copper pipes is very simple. Since the circulation is forced, there is no need to worry over levels; the pipes can run up over the tops of doors or drop down to pass under the cills without greatly affecting the flow, although too many bends will introduce friction losses and demand a larger pump than would otherwise be needed. Since the system is virtually a closed one, there need only be air vents at the highest points to release air during the initial filling.

Being small the copper pipes are not unsightly even if left bare. But their small size also means that it is comparatively easy to encase them. A simple extension to the skirting or an enlarged picture rail is sufficient. In keeping with the system, panel type radiators can be used, fed either from below or from above, the pipes in the latter case running down beside the window frame and at least partially concealed by the curtains. Skirting heating units can also be used in place of radiators. Pipes are normally fixed in stand-off clips which give a clearance to the wall of about $\frac{3}{4}$ in.

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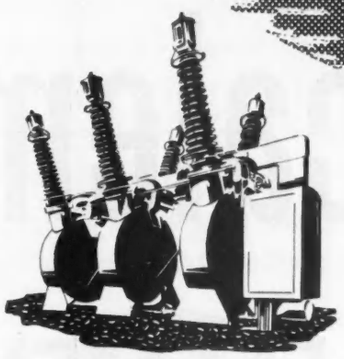

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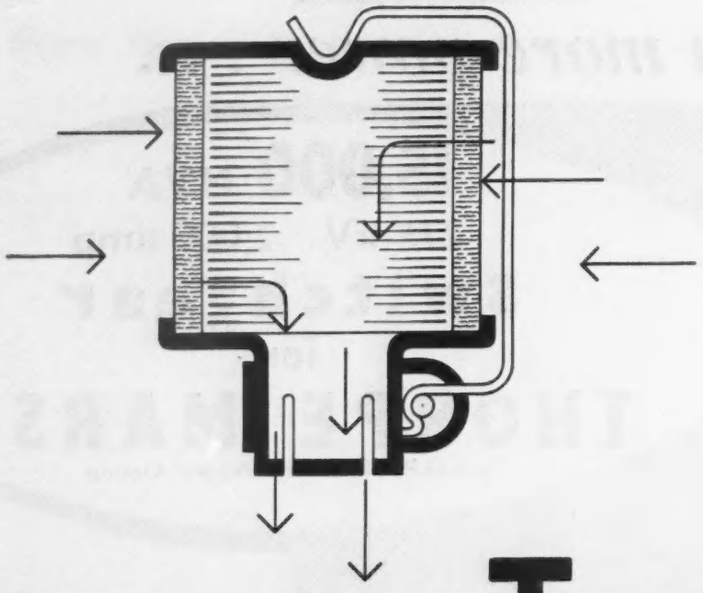

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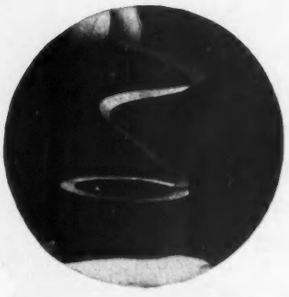

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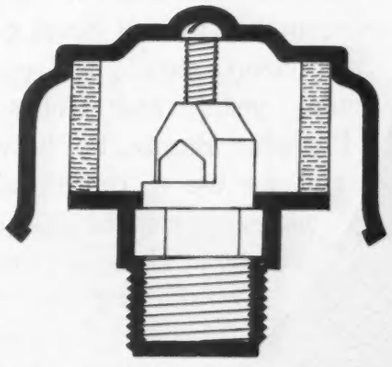
Of the standard types, two are breathers with screwed bodies, available in a range of British and American threads, and the third is a combined clip-on assembly of breather and filler cap, replacing the standard "pan-scrubber" type filter.



All are fitted with Tecalemit Ribbon Filter Elements, and are suitable for engine crankcases; air and vacuum brakes; hydraulic oil tanks and rams; gearboxes, pneumatic cylinders and servo mechanisms, etc.

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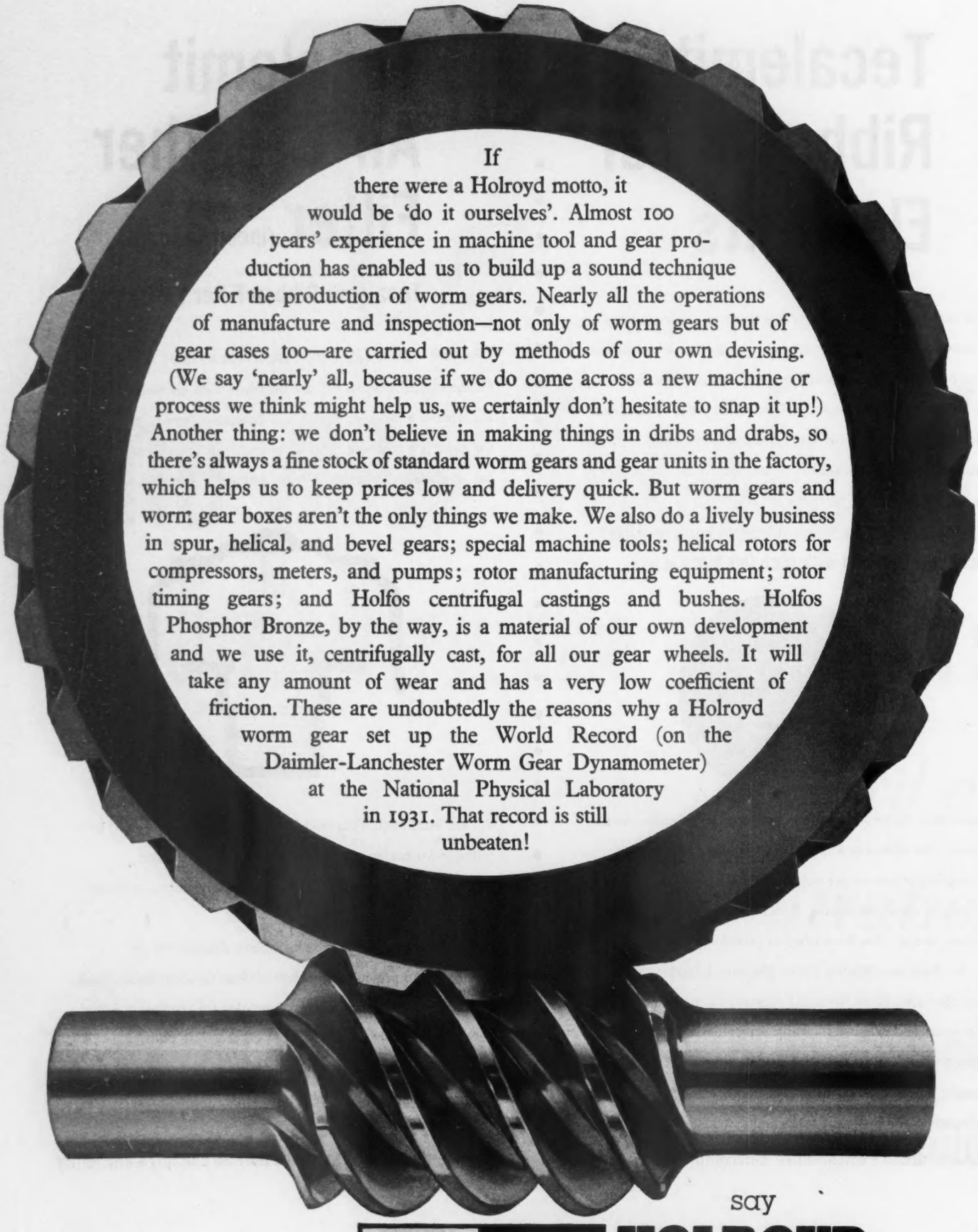

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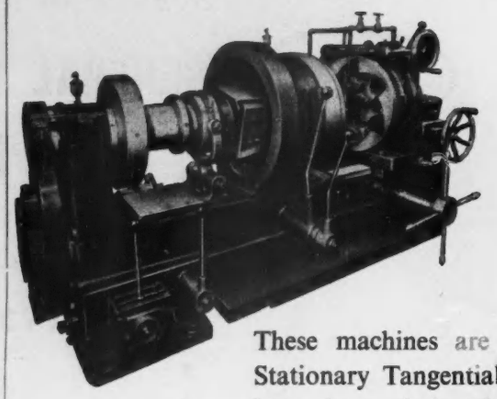

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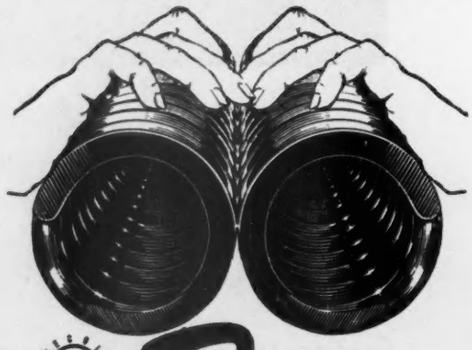

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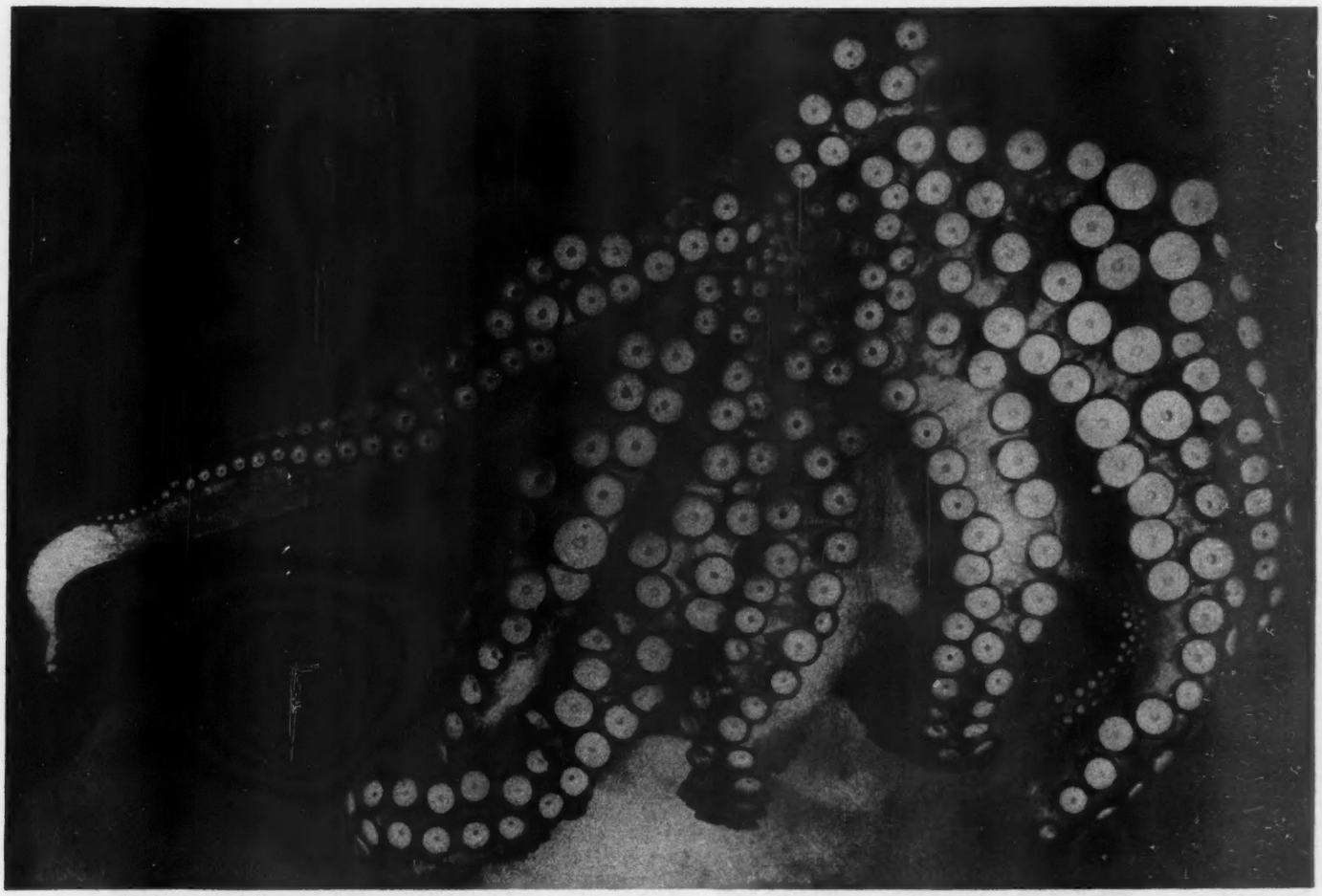

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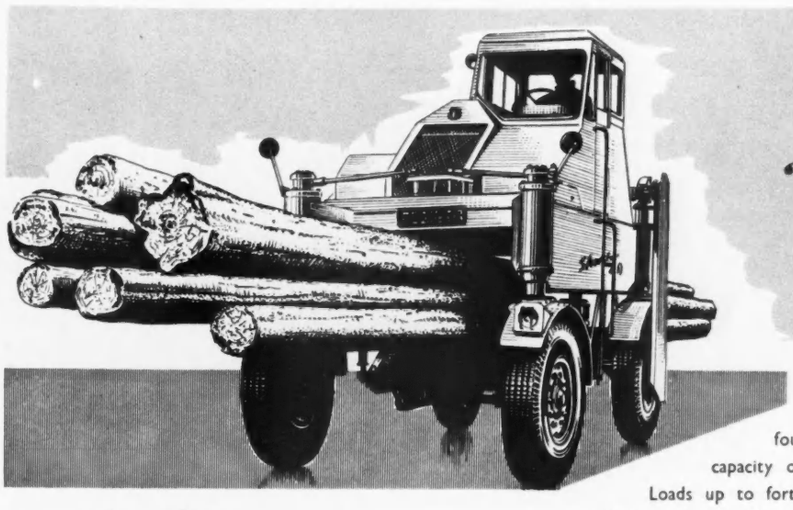

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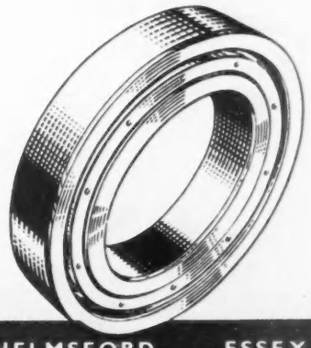

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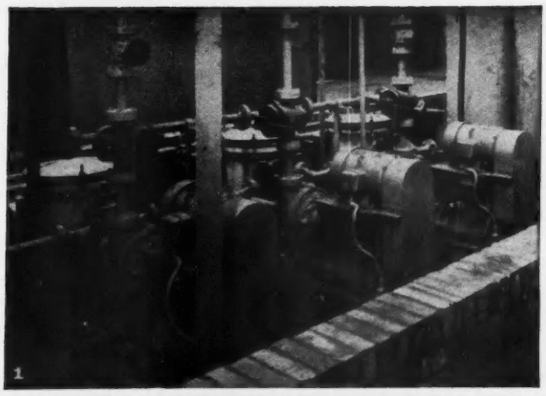

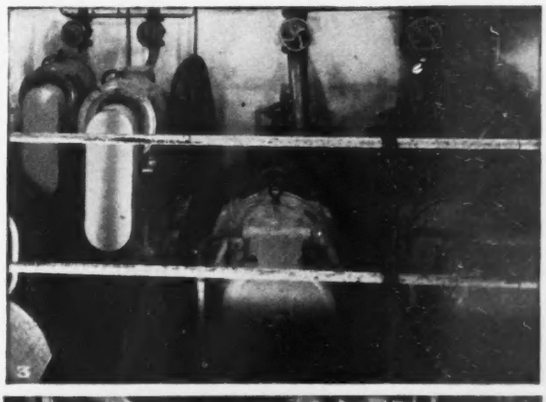

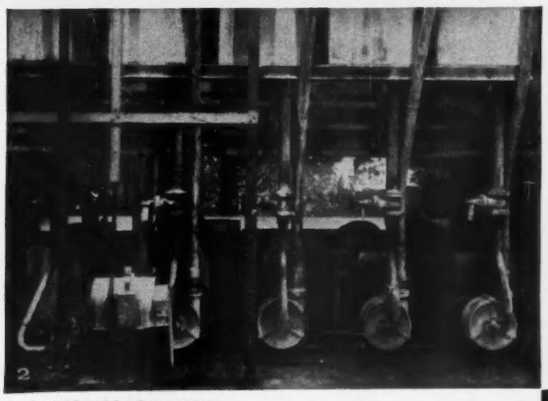

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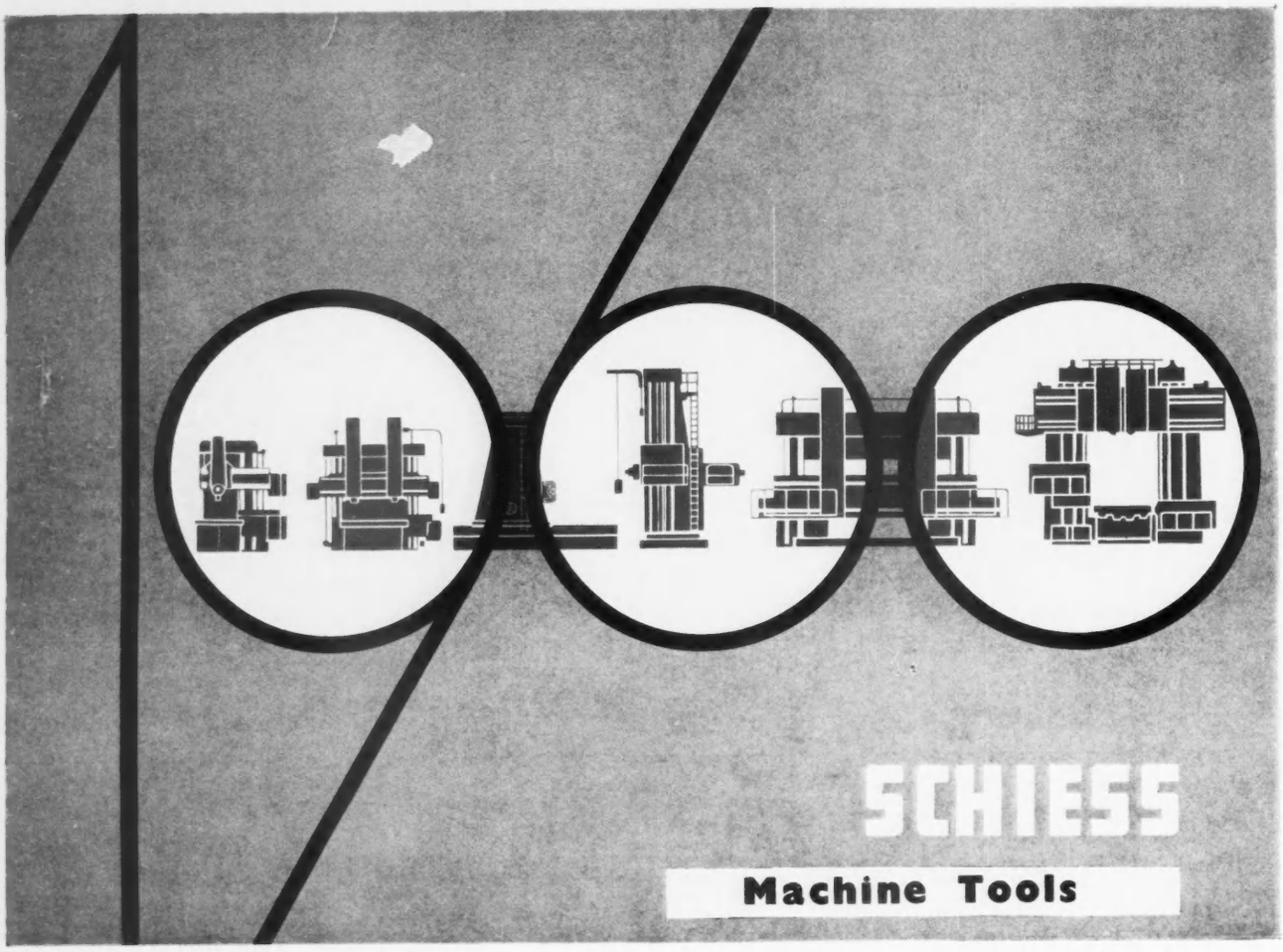

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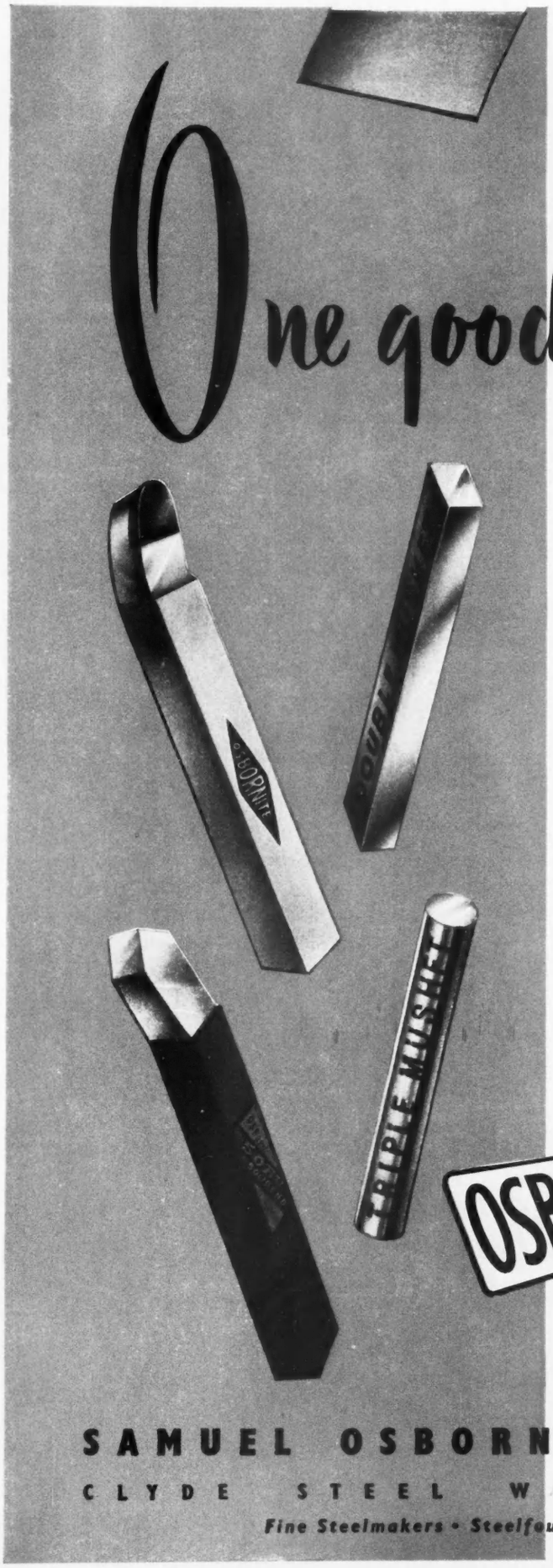

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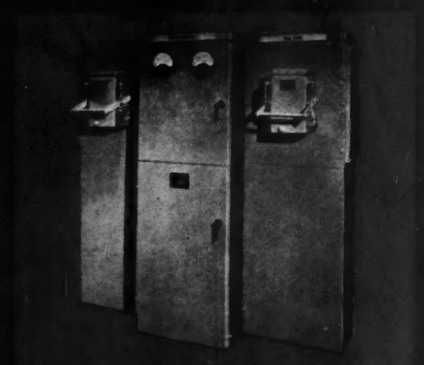

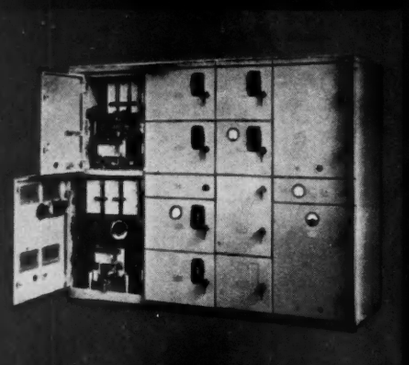

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OUTDOOR OIL CIRCUIT BREAKERS
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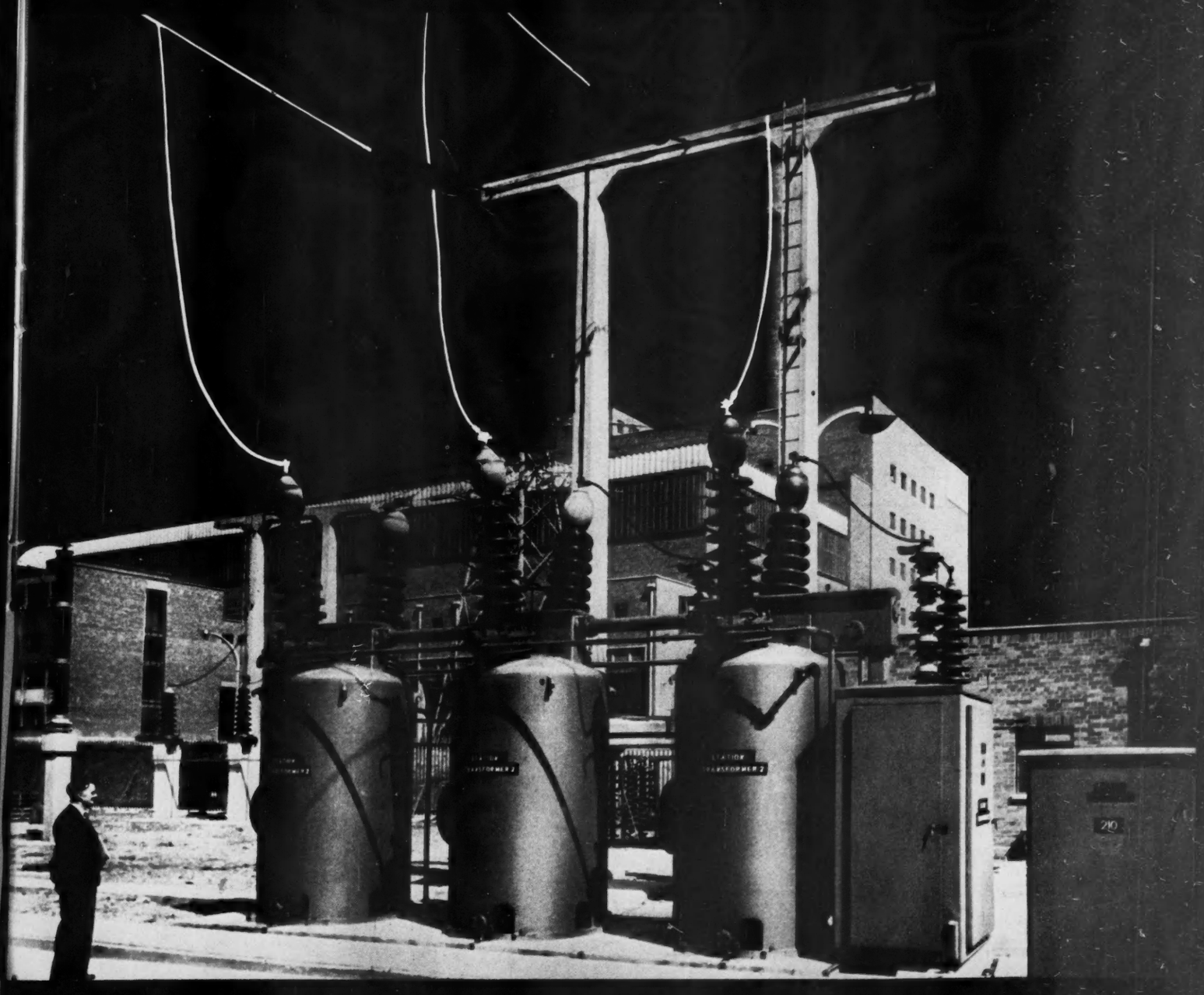
You are invited to ask for the Technical Descriptions of the above switchgear



G.E.C. power control equipment

THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND

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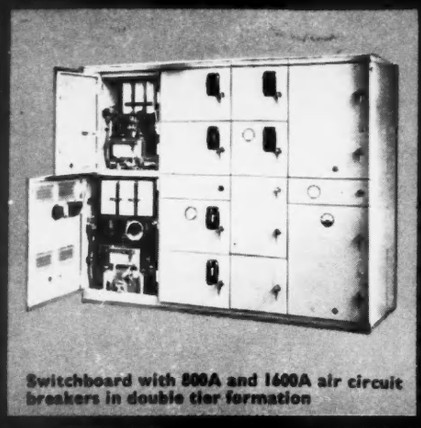
on guard

Extensible ring main, type KAA4 using two type DA4 oil switches



Switchboard with 800A and 1600A air circuit breakers in double tier formation

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METALCLAD SWITCHGEAR
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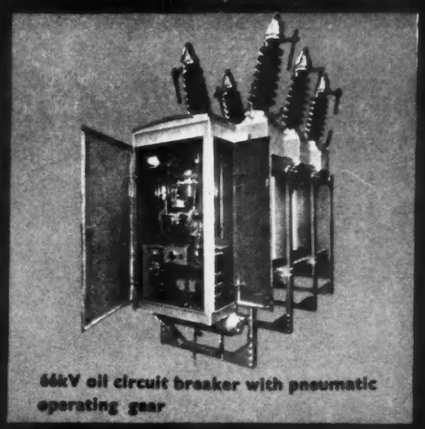
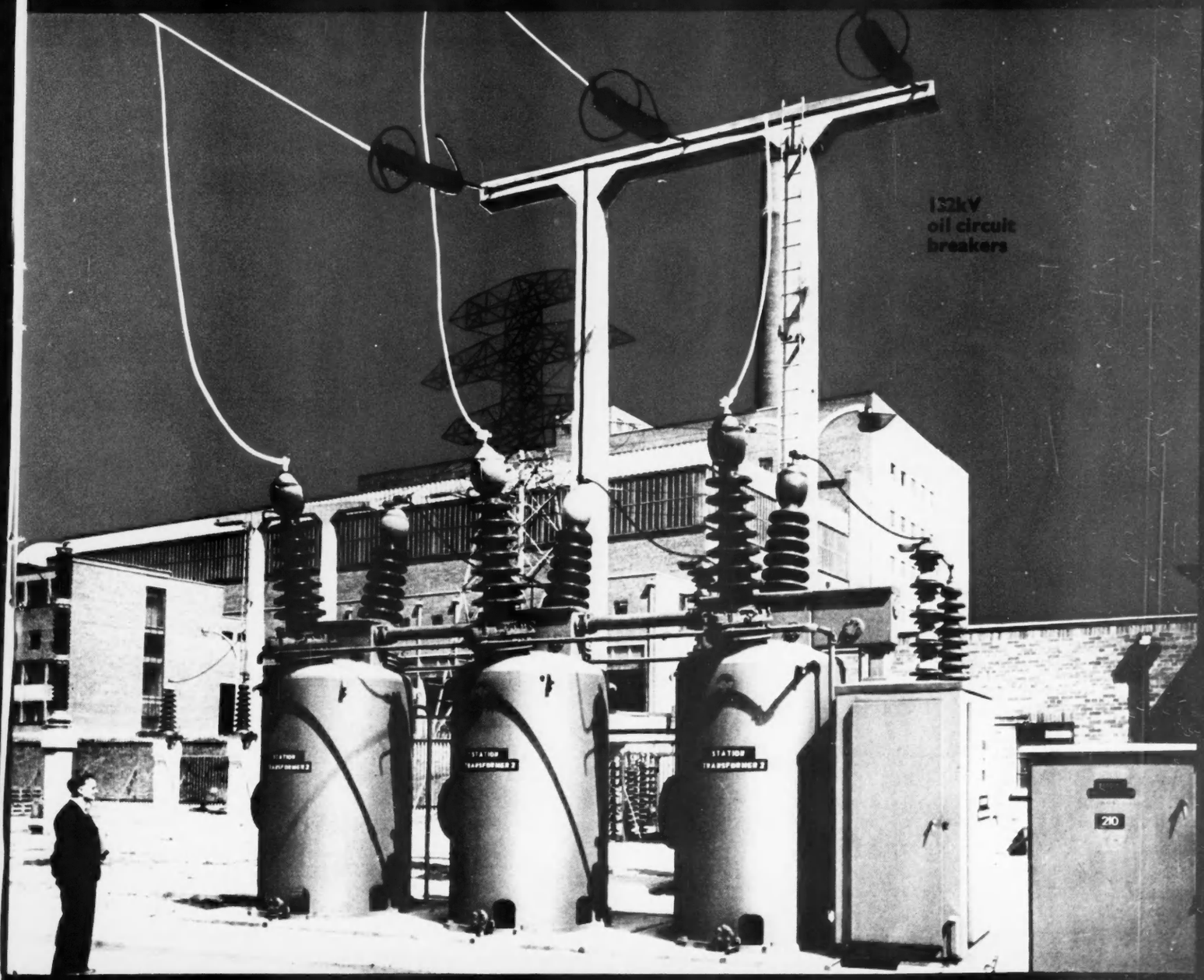
OUTDOOR OIL CIRCUIT BREAKERS
11kV to 132kV—up to 5000 MVA at 132kV. Breakers up to 750 MVA at 33kV available from stock.

You are invited to ask for the Technical Descriptions of the above switchgear

33kV, 750 MVA metalclad switchboard



66kV oil circuit breaker with pneumatic operating gear



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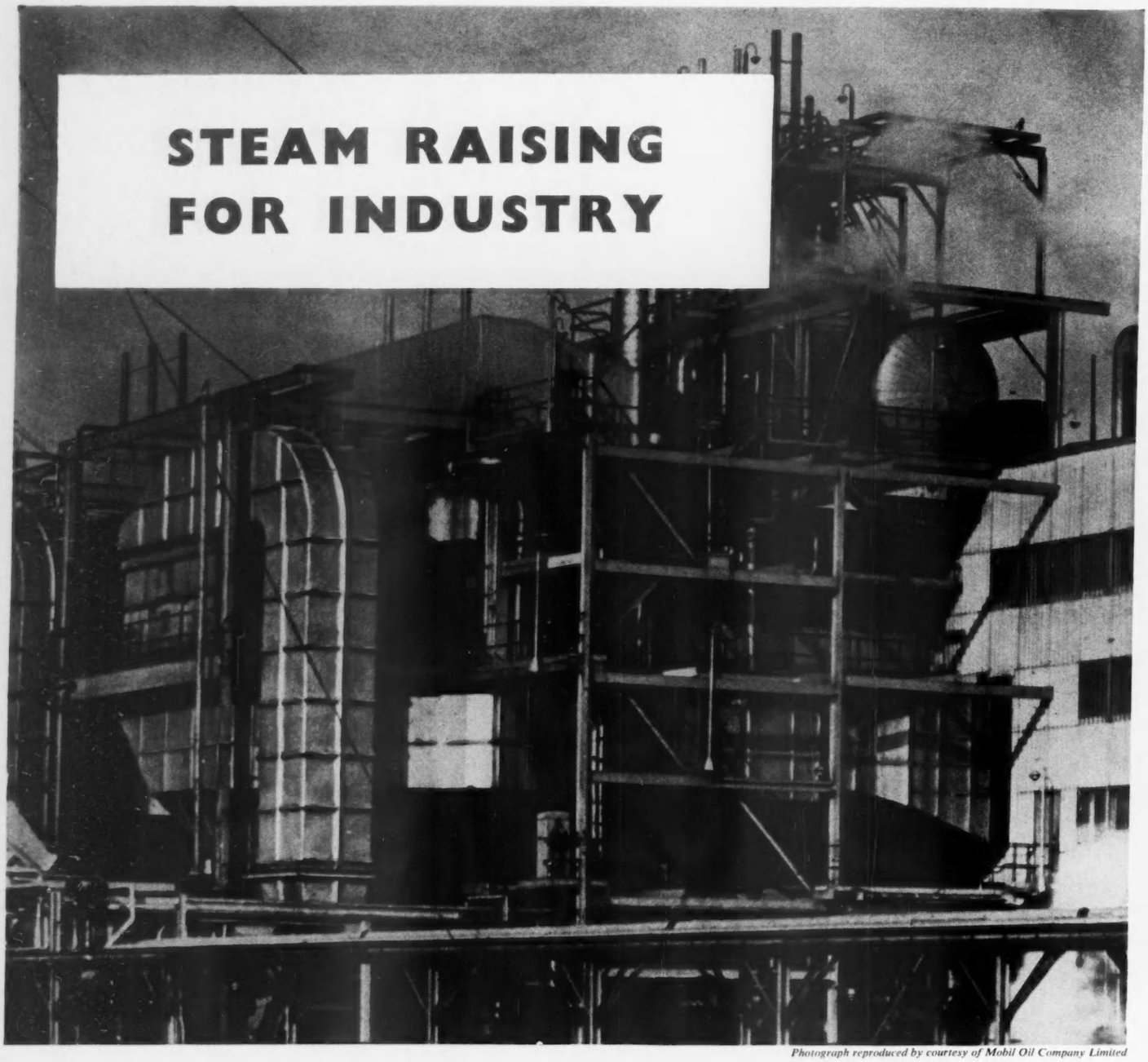

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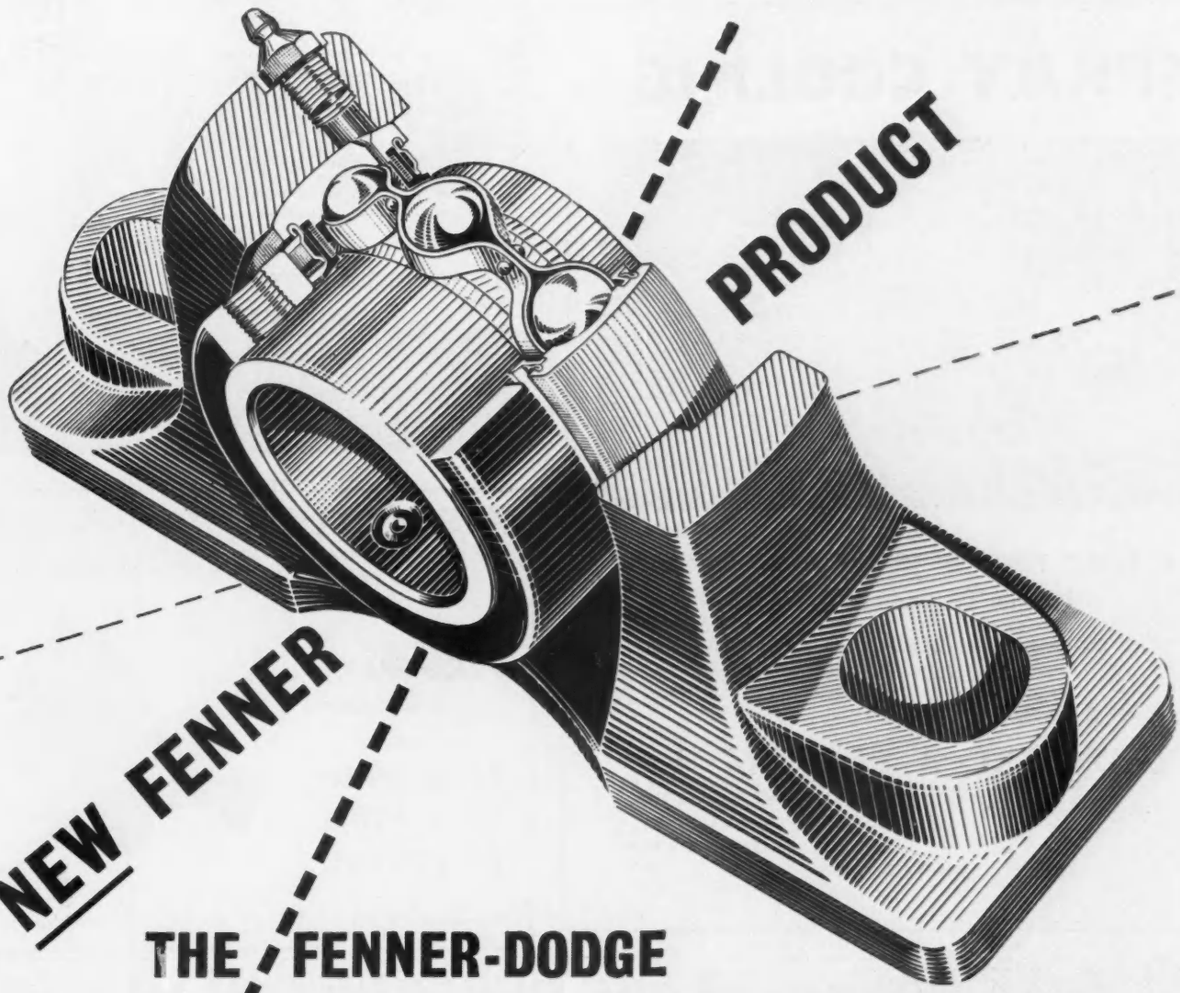

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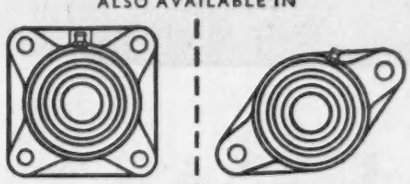

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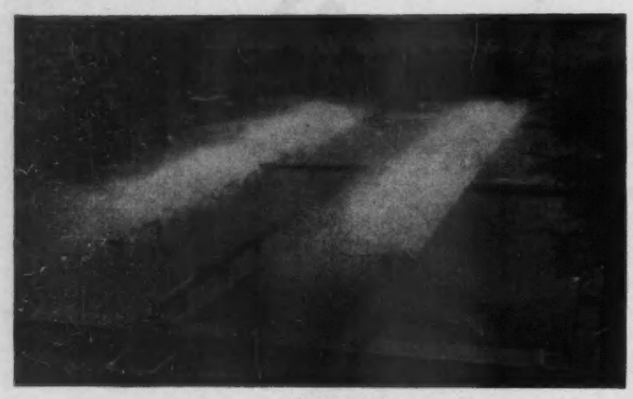

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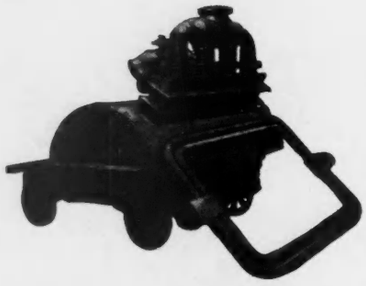

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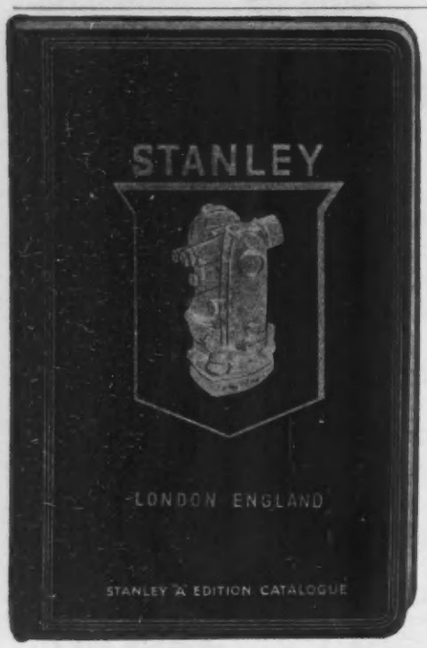

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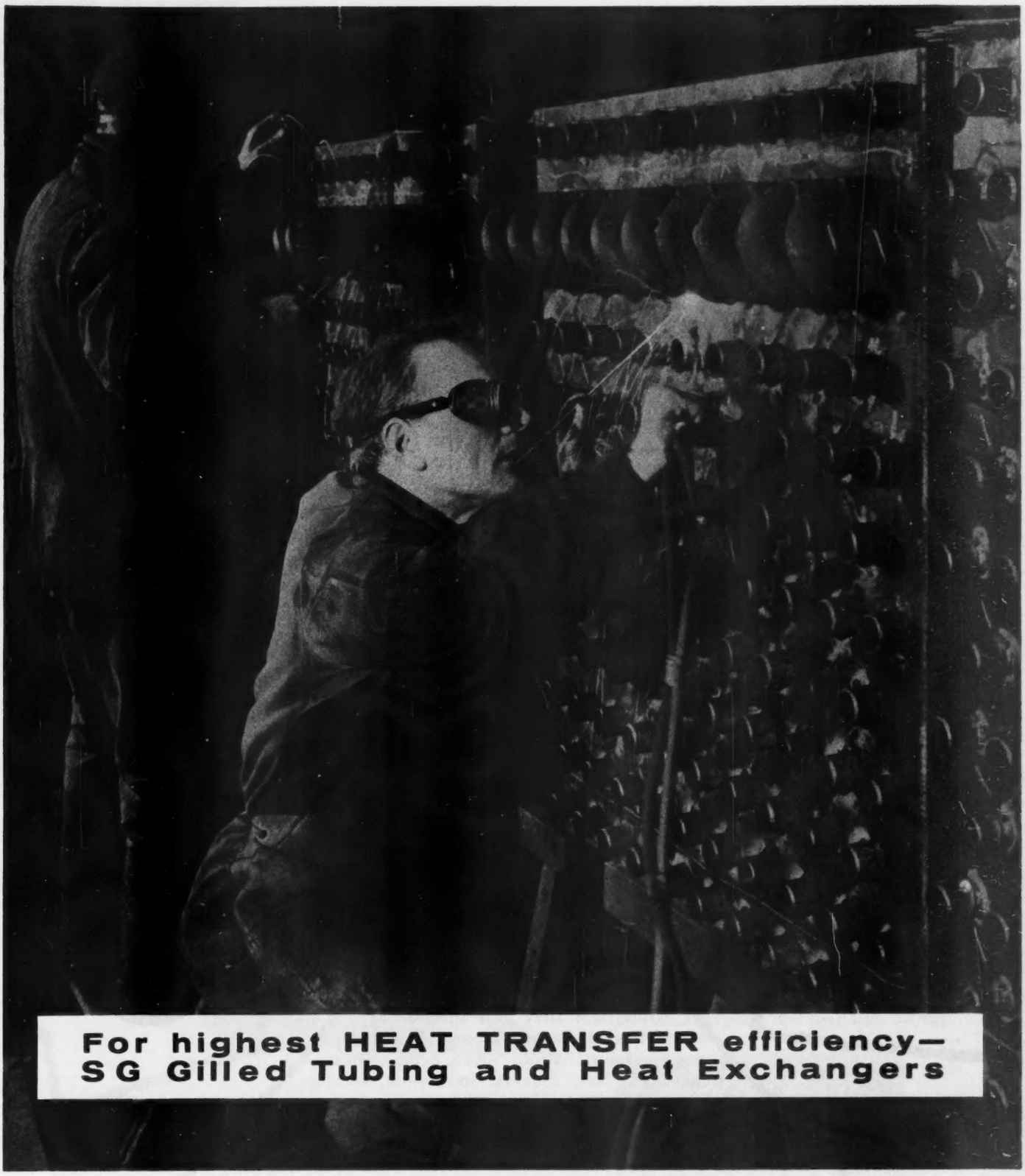

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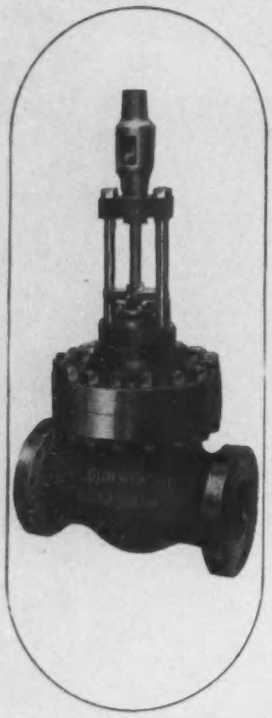

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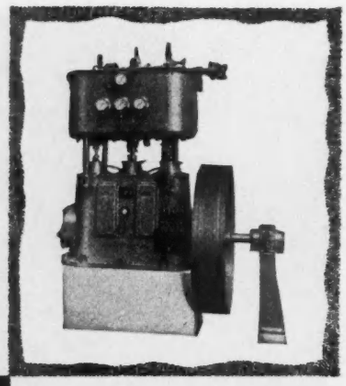

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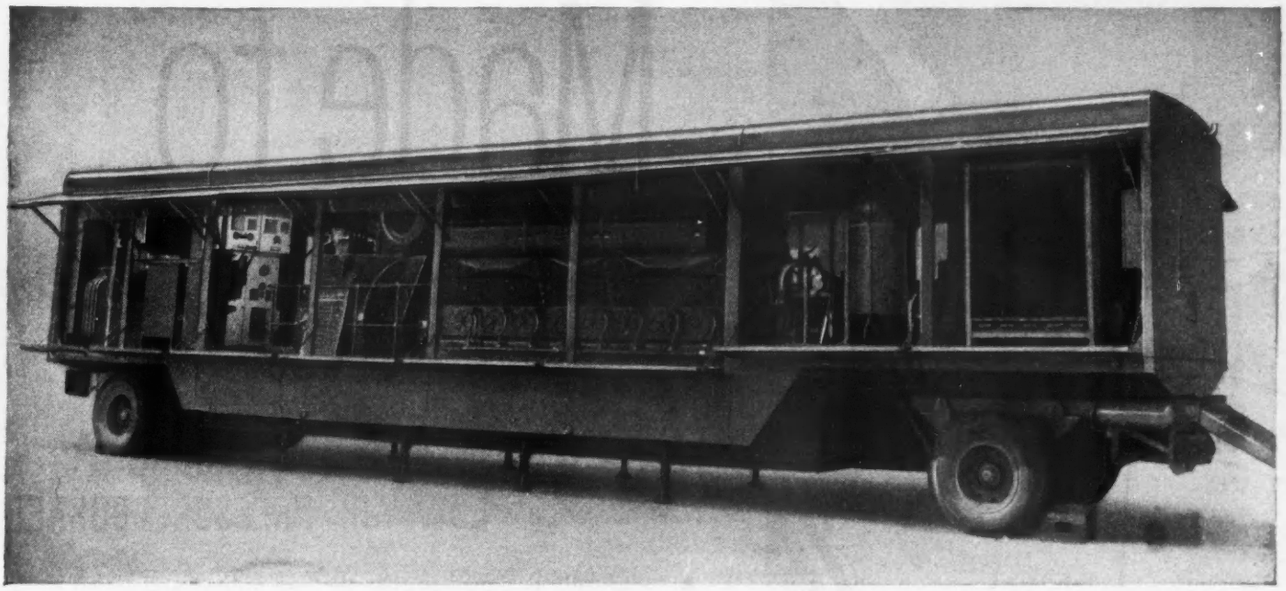
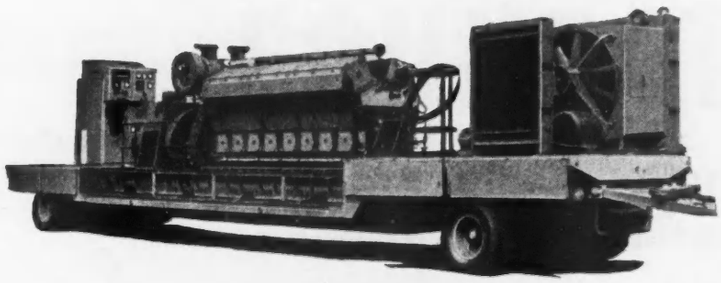
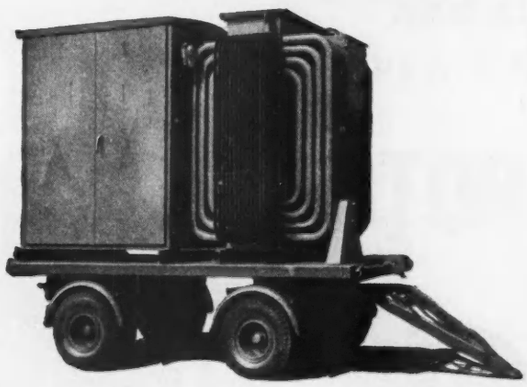


Mobile Power for Venezuela





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* **The photographs show:—**

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CENTRE: *Mirrlees JVS.16 diesel engine and Brush generator in process of being fitted on Generation Trailer.*

BOTTOM: *Transformer Trailer. Weight approx. 10 tons. 12 ft. 6 ins. long, 7 ft. 6 ins. wide, 12 ft. high.*

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diesels

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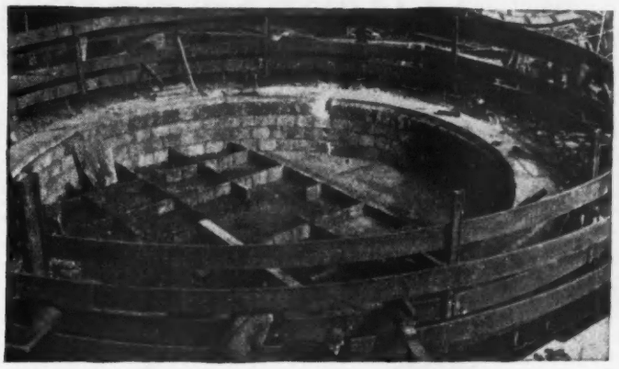

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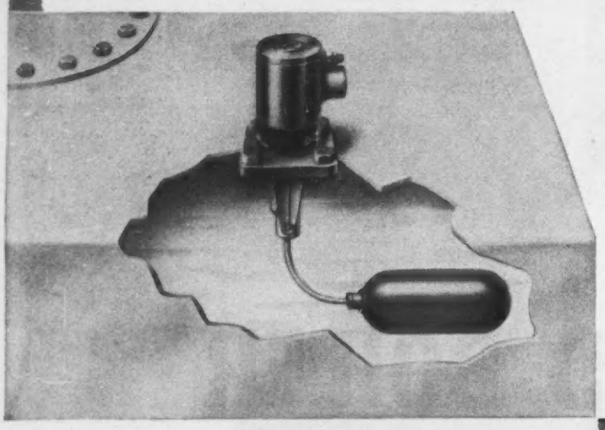

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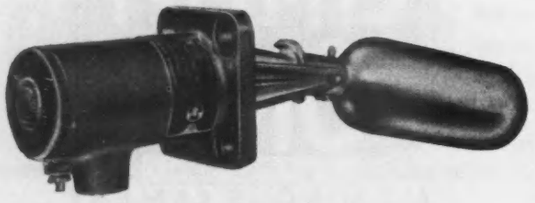

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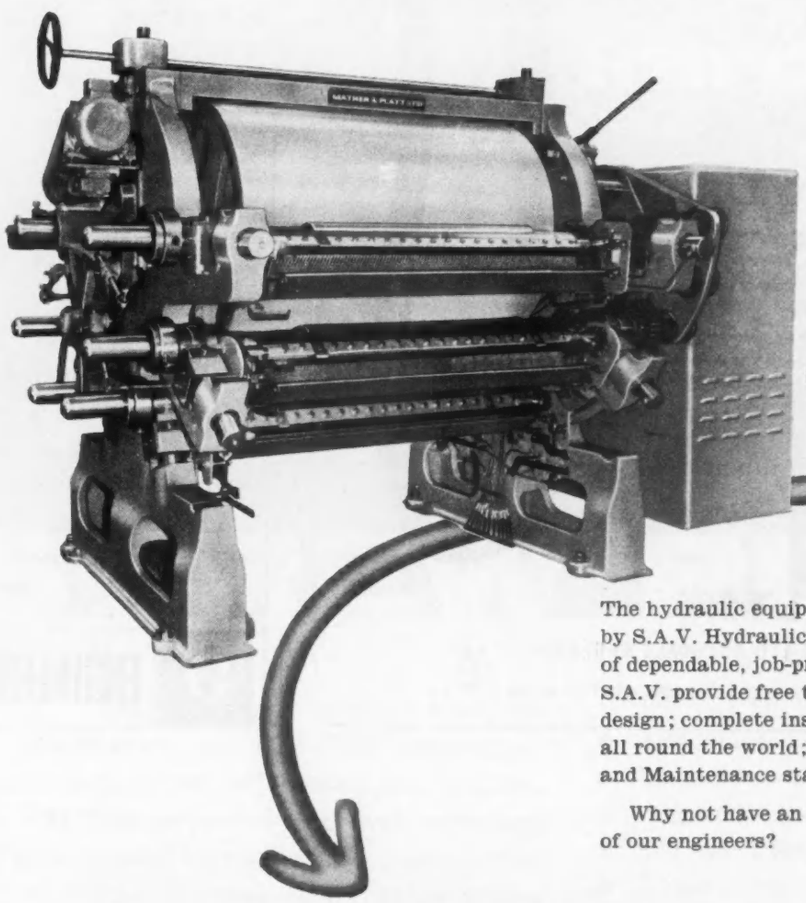

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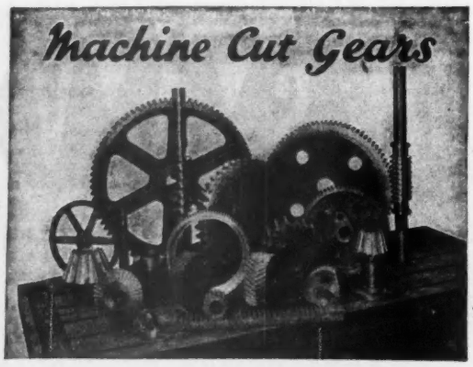

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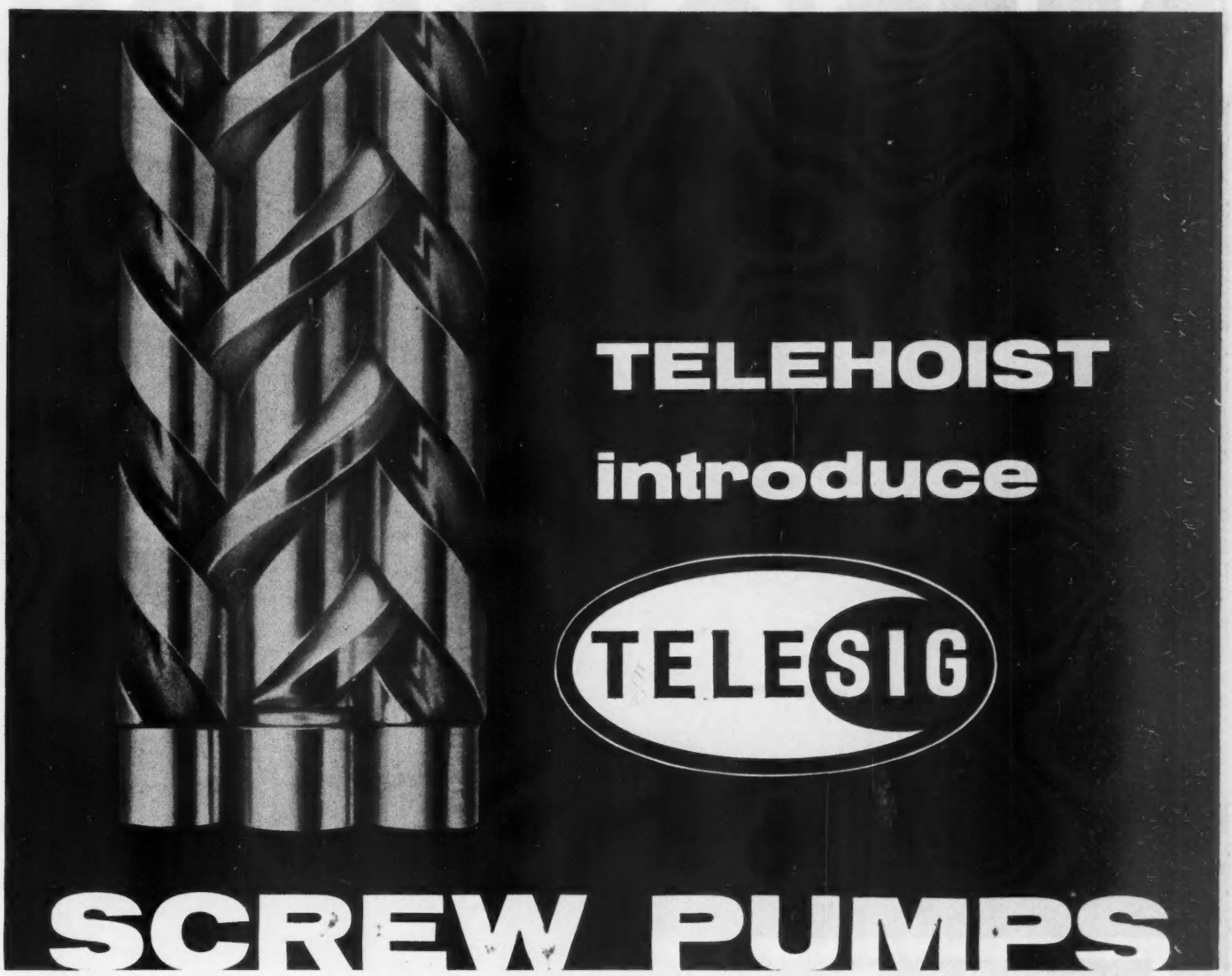

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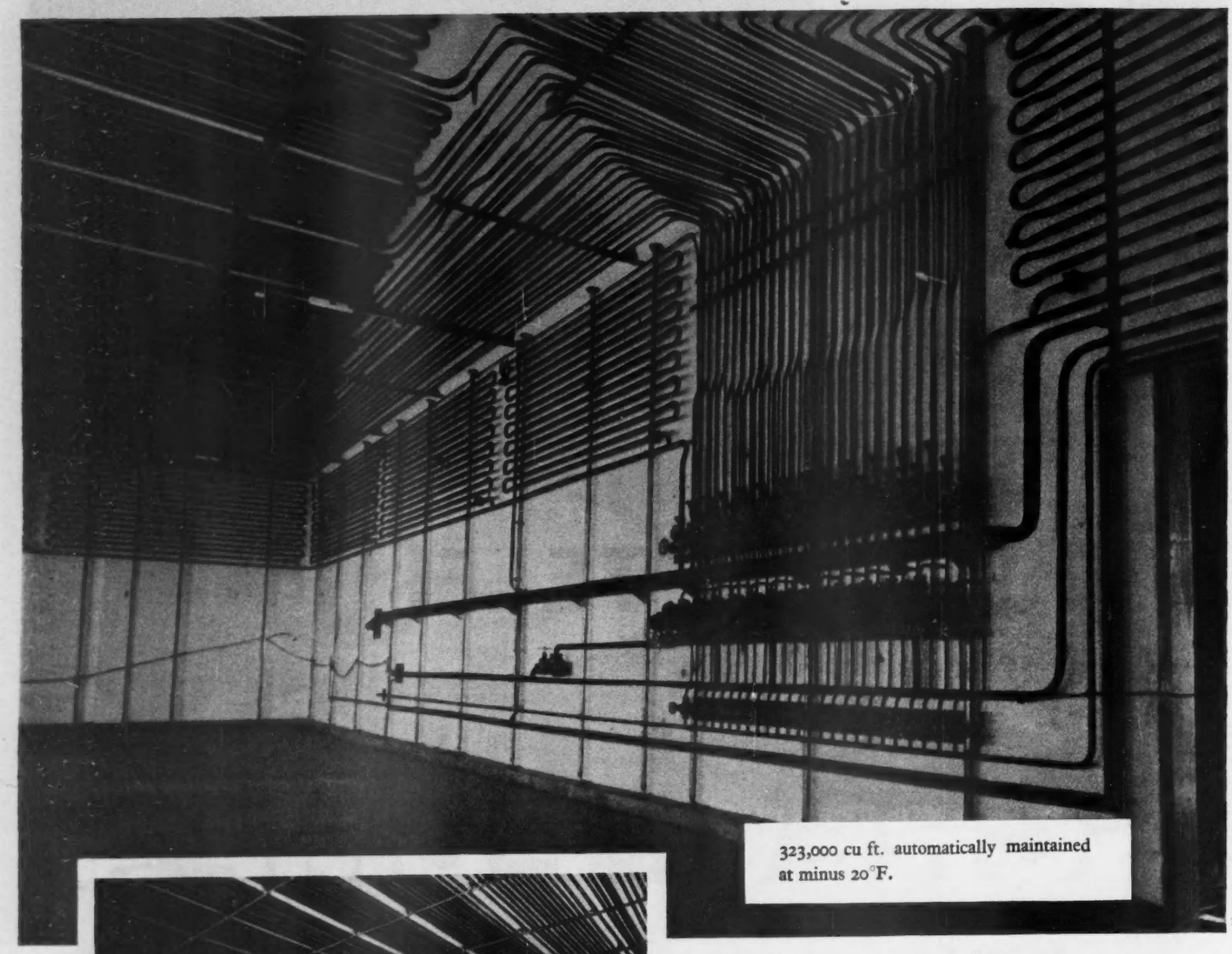

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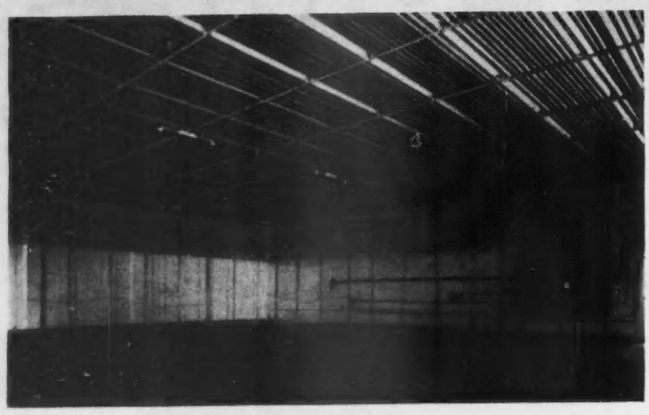

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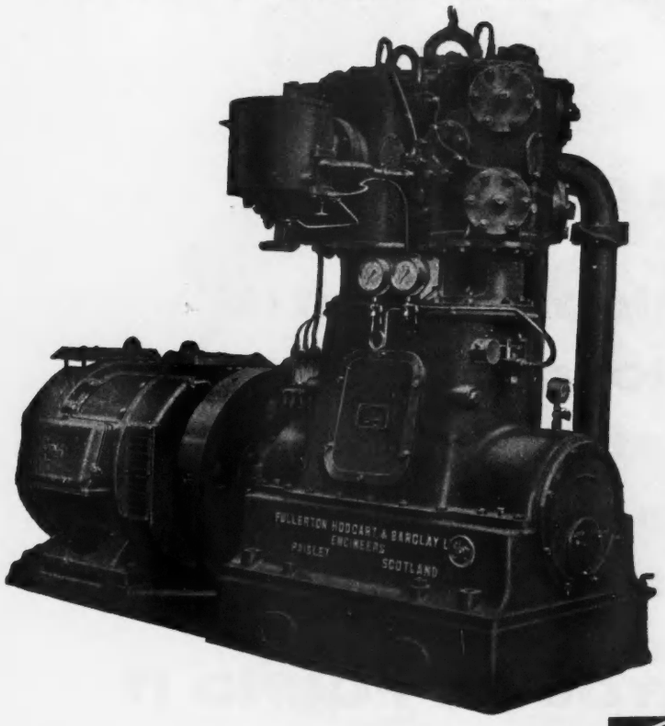

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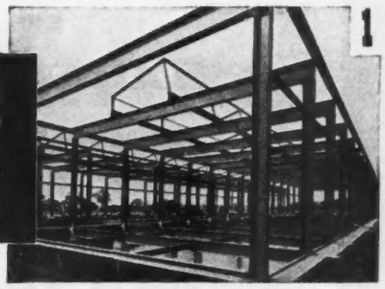

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2 The Completed College. Stage I.

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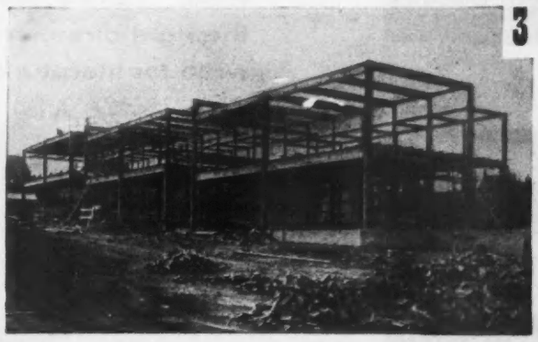

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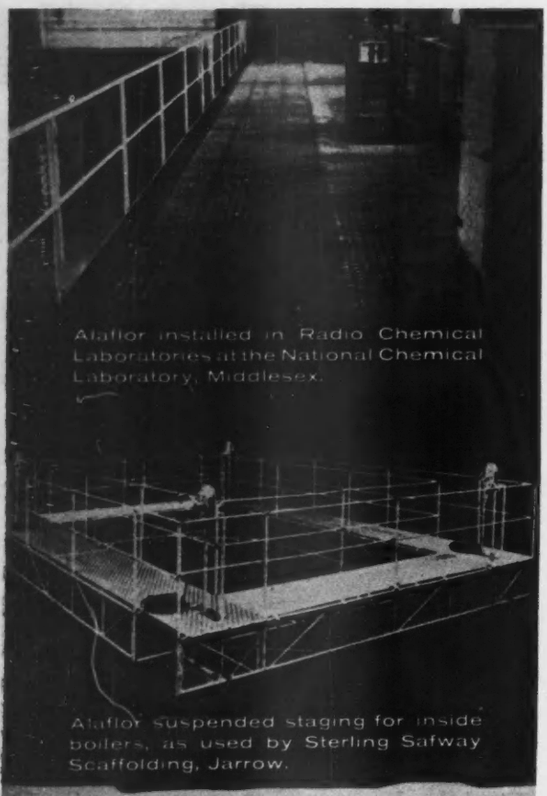

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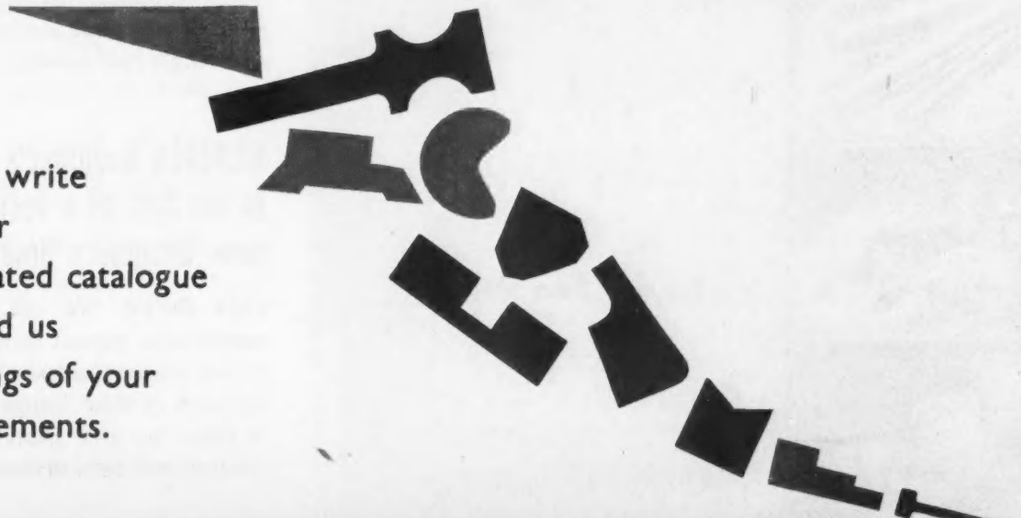

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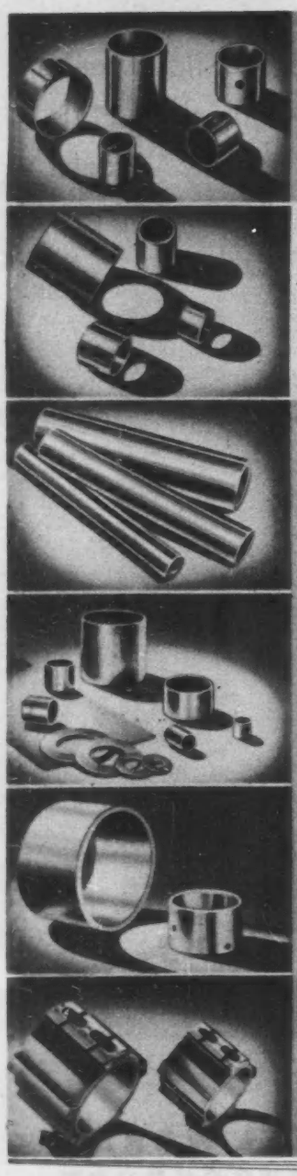

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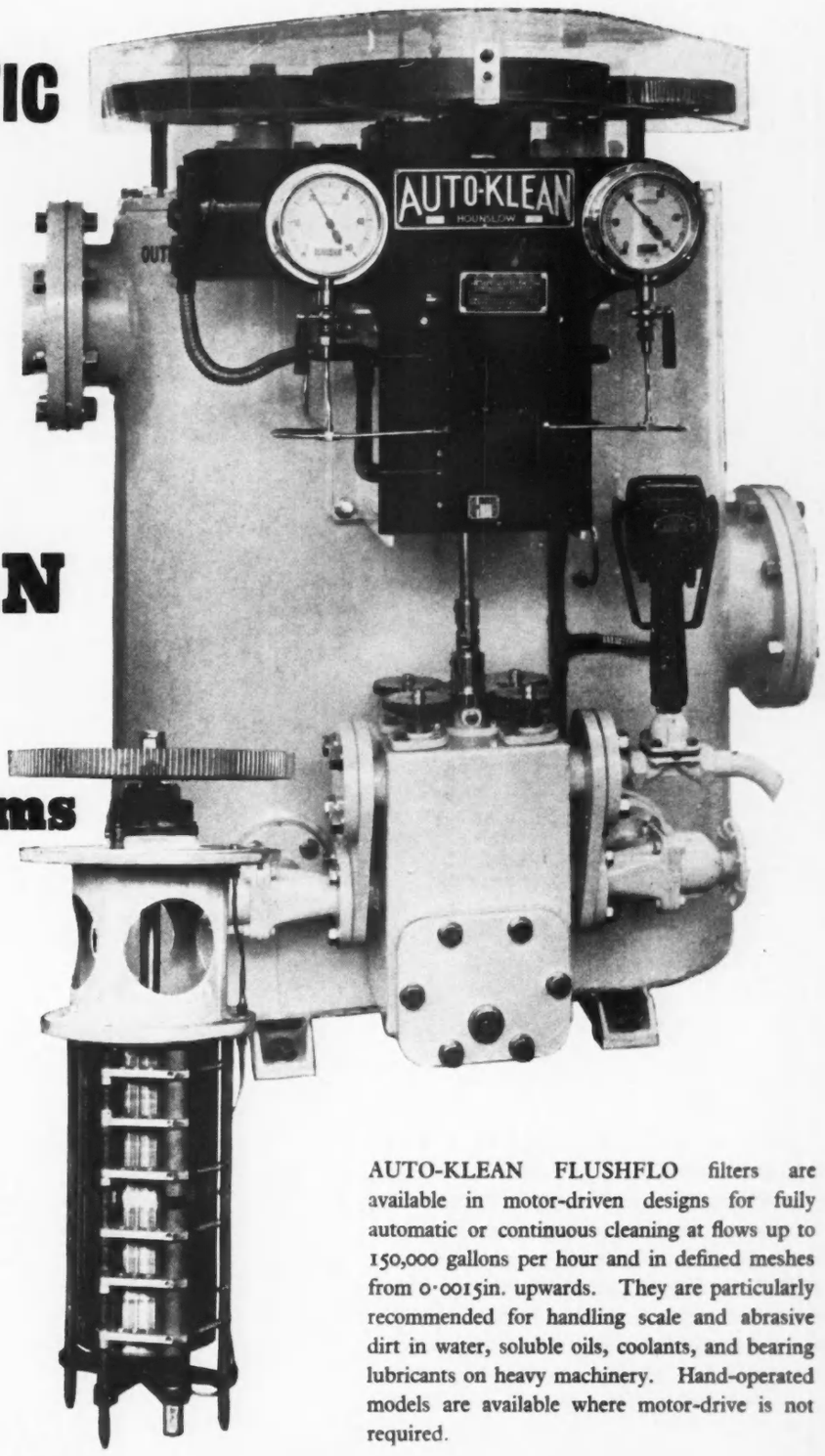

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